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Energy management in Louisiana's public school districts

Acosta, Debra T., Ph.D.

The Louisiana State University and Agricultural and Mechanical Col., 1993

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ENERGY MANAGEMENT IN LOUISIANA'S PUBLIC SCHOOL DISTRICTS

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in the

School of Vocational Education

by
Debra T. Acosta
B.S., Louisiana State University, 1980
M.S., Louisiana State University, 1985
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ABSTRACT

Revenues for public education are declining and school budgets are being evaluated for ways to cut waste. The maintenance and operations budget often falls victim to the budget ax as maintenance on equipment and buildings is deferred. It may be that as a result of the deferred maintenance, school districts are actually spending more on maintenance and operations and energy than before.

This study sought to determine the status of energy use in Louisiana's 66 public school districts and to determine the need for an energy management education program in those districts. Data for the 1991-92 school year were collected using a mailed questionnaire from 55 of the 66 public school districts. Intensive non-response follow-up procedures were instituted to obtain a complete profile of the existing energy expenditure situation in the state's public school districts. Per square foot expenditures for energy were calculated for the 55 school districts that responded. A per student expenditure for energy was calculated for all 66 school districts. Per square foot and per student expenditures for energy and for maintenance and operations for were compared to the state average and to the southern region average. The relationship between per student and per square foot expenditures was determined. The relationship between maintenance and operations and energy was also examined. School districts within the state were prioritized in order of need for an energy management program.

Respondents rated 14 energy-related concepts as to their perceived importance for inclusion in an educational program on energy management for school maintenance and operations personnel.

Findings indicate that a wide variation of per student and per square foot expenditures for energy and maintenance and operations exists within the state. Louisiana school districts spend slightly less per student and per square foot for energy than other southern states. Considerably less per student than the regional average is spent on maintenance and operations. No relationship was found between energy expenditures and maintenance and operations expenditures. It is recommended that energy management education become a high priority with school districts as a means of cutting expenditures.

CHAPTER 1

INTRODUCTION

Purpose of the Study

The primary purpose of the study was to describe the status of energy use in Louisiana's public school districts. It sought to determine a per pupil and per square footage expenditure for energy and for maintenance and operations during the 1991-92 school year in the state's 66 public school districts and to determine the relationship between energy use and maintenance and operations expenditures. The need for a statewide energy management education program was determined and energy management concepts to be included in the educational program were identified.

Justification

Louisiana's economy is in a financial crisis situation. Estimations are that the state is facing a shortfall in its FY '94 state budget of nearly $700,000,000 (Scott, Richardson & Jamal, 1992). Proposals presented to the state legislature to eliminate the shortage include a reduction in the budgets of most state agencies and/or raising additional revenues through taxation (Shuler, 1992). Although the $1.8 billion in state funds provided to local school districts has been protected by the constitution, public elementary and secondary education may not be totally exempt from budget cuts. As was indicated in the 1992 Constitutional Convention, some lawmakers in Louisiana believe it is time for a change to be made in the funding for local

schools (Myers, 1992b). If this change occurs, local school districts could lose a large portion of the revenues on which they operate. Cuts to education could affect Louisiana's educational system and have an impact on Louisiana's future. Regardless of what happens, almost certainly fewer dollars will be available to spend on the education of children. Therefore, school administrators must take a hard look at all aspects of current school expenditures and determine where dollars can be saved. Curriculum and instruction, special programs, personnel, operations and maintenance, capital outlay, and transportation expenses must be closely scrutinized. Vander Vliet (1993) emphasized that limited resources must be channeled into programs that most affect a child's learning. He stated that auxiliary services and energy expenditures must be better managed. Research has shown that there is a direct relationship between energy costs to schools and the type of educational programs they can provide. A 1977 study by Bontrager and Hubbard indicated that as energy costs rise, the quality and scope of programs that can be offered to students decline proportionally because fewer dollars are available to fund such programs.

It has been a common practice that, as budgeted dollars become tighter, the appropriations for maintenance and operations are the first to be cut in school budgets. It is the opinion of some decision makers that operations and maintenance is the easiest budget category to trim without producing an immediate impact on students, faculty and staff (American

Association of School Administrators, Council of the Great City Schools and National School Boards Association, 1983; Shaw, 1993). However, by scrimping on operations and maintenance, school systems actually may spend more in the long run, and may be faced with higher expenditures on utilities and/or manpower due to the inefficient operation of energy consuming equipment (Shaw, 1993). Decision makers in the school systems must be convinced that spending money up front for preventative maintenance will, in the long run, save the school districts' tax dollars. A sound preventative maintenance program can minimize disruption of service, reduce repair costs, lengthen the life of equipment and reduce energy consumption (Migliorino, 1980).

In 1991 and 1992, school superintendents in Louisiana realized the need for energy conservation in their facilities and turned to the Louisiana Cooperative Extension Service (LCES) for help in managing dollars allocated for the operation and maintenance of school facilities and developing an energy plan (Louisiana Cooperative Extension Service, 1992). Zachar (1985a) defined an 'energy plan' as a "roadmap of how to move dollars from the utility account to the academic account" (p. 8). Zachar purports that this 'energy plan' identifies policy changes and capital improvements to be made, as well as necessary changes in operations and maintenance required to reduce energy consumption.

In a 1992 school energy management pilot program by LCES and the Louisiana Department of Natural Resources (DNR), an energy plan was devised for four school districts in South Louisiana. Twelve schools were audited and recommendations were made to school administrators for no-cost/low-cost modifications that could be made to lower energy consumption. The recommendation made by LCES faculty and DNR Energy Division personnel was the same as a 1985 recommendation made to Louisiana school administrators by DNR--rather than cut maintenance and operations from the school budget, implement a plan which includes reduced energy consumption, more efficient equipment utilization, and methods for monitoring energy consumption and costs (Louisiana Department of Natural Resources, Energy Research and Planning Division, 1985; Louisiana Cooperative Extension Service, 1992).

In school districts throughout the country, utility expenses are second only to personnel expenses in the overall education budget (California Energy Extension Service, 1989). The utilities portion of the school budget is one to be considered for a substantial reduction in expenditures. The 1992 Extension study revealed increased utility costs and wasteful practices were eroding the educational budget (Louisiana Cooperative Extension Service, 1992). The potential for saving valuable education dollars and rapidly depleting natural resources in Louisiana through energy conservation is tremendous.

When compared with other sectors of the economy, the commercial sector which includes institutions such as schools, consumed the smallest portion of energy in the country from 1960-1990, but continued to show the steadiest increase during the same time period (U.S. Department of Energy, 1992). Although the commercial sector consumes only 4% or 95 trillion BTUs of the energy used in Louisiana, it accounts for one-third of the electricity used in the state annually (Louisiana Department of Natural Resources, Division of Research and Development, 1983).

Educational facilities represent about 6,000,000,000 square feet of space nationally and rank fourth in energy consumption in the commercial sector after offices, retail establishments and warehouses (U.S. Department of Energy, 1984). The Institutional Conservation Program (ICP) of the Louisiana Department of Natural Resources has determined from audits and technical assistance studies of Louisiana schools that the typical school in its program has a gross area of 80,000 square feet, is 20 years old and consumes 90,000 BTUs of energy per square foot at an average cost of $0.24 per square foot (Louisiana Department of Natural Resources, 1992). The average energy ratio is 1/3 electricity to 2/3 natural gas. Estimates resulting from audits of selected Louisiana schools by the Louisiana Cooperative Extension Service found school systems spending from $45 to nearly $300 per student annually on electricity and natural gas (Louisiana Cooperative Extension Service, 1992). Monthly utility bills of $14,000 and

above per school can quickly deplete the amount of money available to spend on the actual education of Louisiana's most valuable future human resource--students.

It is estimated that 85% of the schools in Louisiana were designed and built prior to 1970 and are quite inefficient by today's energy standards (Louisiana Department of Natural Resources, Division of Research and Development, 1983). Many schools were built in the 1950s, before the advent of air conditioning and were designed with entire walls of windows to take advantage of natural ventilation. When air conditioning was added to many of the buildings in the mid 1970s, the windows contributed to the energy waste problem by allowing solar heat gain and air leaks.

Budget dollars available for maintaining educational facilities have been minimal and many schools are presently in poor condition. Nearly 5,000,000 American public school students attend classes in substandard buildings (American Association of School Administrators, 1992). In addition, the Asbestos School Hazard Abatement Act of 1984, PL-98-377, mandated the removal or encapsulation of asbestos from all schools due to the effect asbestos was believed to have on the health of children (United States Statutes at Large, 1986). It was determined that a substantial amount of asbestos was used in school buildings constructed between 1946 and 1972, which includes the majority of schools in Louisiana. In many cases, the asbestos, which provided insulation for the buildings, has been removed to

comply with the mandate and has not been replaced with any other type of insulating material. Consequently, many older Louisiana schools are totally uninsulated and the remainder are underinsulated.

Energy waste has been observed in walk-through audits conducted by LCES energy and engineering specialists in 12 south-central Louisiana schools (Louisiana Cooperative Extension Service, 1992). The lack of knowledge regarding energy management that exists among school administrators, faculty, and staff, combined with the serious manpower shortage of maintenance personnel in most school systems, gives credence to the need for an expansive energy education effort. This substantial energy waste is not unique to Louisiana schools. Smith (1986) reported that inefficient equipment, non-functioning temperature controls, deferred maintenance and poor design of original buildings are the main reasons that school systems throughout the country are consuming more energy than is necessary. The potential exists for school systems to make changes which will increase the energy efficiency of school facilities.

In the past, local power companies performed energy audits of schools and helped to educate school administrators and others regarding energy management. They also provided energy education materials for use in the classroom. However, in recent years, as power companies' budgets have become limited, their roles as energy conservation education entities have been greatly reduced. Therefore, a need exists to fill this void. LCES is

working to implement an energy management program for Louisiana schools which will attempt to fill this educational need. The program will assist local school systems in making the best use of the financial resources available for support services, namely utilities.

Aside from the obvious economic advantage occurring from an energy management program of reducing utility bills, there are many other advantages which have a more subtle economic effect. Improved indoor air quality, improved occupant comfort, lower maintenance costs, lower energy consumption and improved public relations for schools showing wise use of budgeted dollars are additional benefits. Improving the indoor air quality in a facility improves occupant comfort. Students and teachers both perform better if they are in a comfortable environment. The Carnegie Foundation reported in 1988 that student attitudes about education are a direct reflection of their learning environment. In other words, if students are comfortable in the learning environment they will be more receptive to learning (cited in American Association of School Administrators, 1992). An independent study by Washington, DC schools in 1991, cited in American Association of School Administrators (1992), concluded that student achievement on standardized tests would be 5 to 11% higher if physical conditions in the schools were improved.

Heating, ventilation and air conditioning (HVAC) systems functioning improperly contribute to reduced indoor air quality. The growth of mold and

mildew and the breeding of germs are common problems in buildings without adequate ventilation and in HVAC systems which have not been properly maintained. With improved air quality comes fewer days lost in the classroom due to sickness of teachers and students and lower maintenance costs due to painting and cleaning of schools.

Energy Expenditures in Schools

Several factors influence the energy expenditures by school systems such as the age of the buildings, building materials utilized in construction, the general design of the building, its geographic location, the orientation of the building on the site, the maintenance schedule utilized and the day-to-day practices of the schools' occupants regarding energy-consuming systems (Louisiana Department of Natural Resources, Energy Research and Planning Division, 1985). In the 1992 energy audits of Louisiana schools by the Louisiana Cooperative Extension Service (1992), each of these factors was studied to analyze its effects on energy consumption. Observations regarding maintenance schedules and day-to-day practices of occupants during the audits confirmed the need for an energy management program for Louisiana schools.

In Louisiana, it is estimated that heating and cooling accounts for approximately 70% of school energy expenditures. Lighting accounts for another 22%. The remaining 8% includes energy required to operate office and kitchen equipment and to heat water (Louisiana Department of Natural

Resources, Energy Research and Planning Division, 1985). In each of these very costly areas of energy expenditures, gross misuse and waste were observed in the 12 schools audited by LCES in the pilot program (Louisiana Cooperative Extension Service, 1992).

Heating, ventilation and air conditioning systems with dirty air filters (and in some cases, no air filters), dirty and greasy coils, improper refrigerant levels, blocked air supply and return grills, broken or improperly set thermostats and inadequate ventilation were typical occurrences in many of the schools visited. Poorly designed lighting, improper lighting levels (both high and low), failure to utilize natural lighting when available and poorly maintained light fixtures also were common.

Additional energy conservation problems noted may be due to inadequate maintenance. Air leaks resulting from broken windows and improperly fitted doors, windows and window air conditioners posed a potential for a great amount of energy waste. Doors which would not close tightly allowed for additional air leakage. Faucets with washers which needed to be replaced dripped hot water. It was concluded that many of the undesirable situations were due to inadequate maintenance and a serious shortage in maintenance personnel.

A recent study by the Louisiana Cooperative Extension Service (Smilie & Carl, 1992) indicated that energy consumption could be reduced by as much as 25% by simply implementing a regularly scheduled maintenance

program on HVAC equipment. Further, the Federal Energy Administration's impact assessment of the ASHRAE Standard 90-75 estimated that commercial and school facilities in the south could reduce energy consumption by 37.9% if the buildings were brought up to standard (1977).

The 1992 LCES study also revealed numerous day-to-day operating practices which defy wise energy management practices (Louisiana Cooperative Extension Service, 1992). Windows and doors in classrooms were open while the air conditioning or heating system was in operation which resulted in the extremely expensive conditioning of hall space and outdoor space. School campuses typically lacked, or improperly used, exterior window treatments such as overhangs, awnings and landscaping to reduce solar gain into classrooms through windows. Computers and other equipment often were left on when not in use. Hot water running or dripping in sinks, showers and hand wash areas unnecessarily were common occurrences. Many faucets simply were not turned off completely. Lights left on in vacant classrooms and storage closets and improperly set thermostats were observed on every campus. Each of these specific situations has the potential for improvement as it relates to energy conservation and management.

The findings of the 1992 Extension study support the critical issues identified by the American Association of School Administrators (1992) concerning energy usage in schools for the 90's which were: (1) poor physical conditions of school facilities; (2) indoor air quality problems; (3)

depletion of revenues for education; (4) low priority of energy-related matters with school administrators; and (5) absence of facility and energy leadership to administrators. As energy costs continue to rise and a larger portion of the financial responsibility for public schools is placed on the state, school administrators will be held more accountable for public tax dollars spent on education. Because of this, administrators must more closely scrutinize spending habits, and in the case of energy expenditures, wasted tax dollars. According to Zachar (1985a), the idea of energy conservation, which in the 1970s created images of long gas lines, rapid price hikes, Mid East conflicts and deprivation, now has moved to a more mature conceptualization. Energy is now viewed as a resource which should be managed like any other resource available to a school.

Objectives of the Study

The objectives of the study were to:

1. determine energy usage and energy expenditures on a per student and per square footage basis for Louisiana's 66 public school districts and to determine the relationship between per student and per square foot expenditures;

2. compare the per square footage and per student expenditures for energy use in Louisiana with the regional averages;

3. compare the per square foot energy expenditures and the per student energy expenditures for each of the 66 school districts to the statewide average energy cost;

4. prioritize the 66 school districts within Louisiana in order of need for energy management assistance, to be determined by per pupil and per square foot expenditures;

5. determine per square foot and per student costs for maintenance and operations;

6. determine the relationship between maintenance and operations expenditures and energy costs; and

7. determine the importance of selected concepts for inclusion in an educational program on energy management for school maintenance and operations personnel as perceived by study respondents.

Limitations of the Study

The following delimitations of the study are acknowledged: (1) the study was limited solely to public school districts and did not include private or parochial schools; (2) the study was conducted totally within the state of Louisiana; and (3) the superintendent of each school district designated someone in the district to respond to the survey and the designee may or may not have been the most appropriate person to respond. The third limitation could result in increased measurement error, if in fact, the designee was not the most appropriate person.

Definitions of Terms

The following terms and abbreviations are used in this report and their definitions are provided to the reader for clarity.

ASHRAE--The American Society of Heating, Refrigerating and Air Conditioning Engineers. Develops and publishes many standards related to the design and application of HVAC equipment.

BTU--British Thermal Unit. One BTU is the amount of heat needed to raise the temperature of one pound of water one degree Fahrenheit. An air conditioner that is said to have one ton of capacity is able to remove 12,000 BTUs per hour.

CCF--One hundred cubic feet. Usually applied to the unit of measurement of natural gas. Example: 15 CCF equals 1,500 cubic feet. See MCF.

CFM--Cubic feet per minute. The unit of measure for the quantity of air flow. A cooling system normally requires approximately 400 CFM per ton. A heat pump usually requires 450 CFM per ton.

degree day--The difference between 65°F and the average high and low temperatures in a given day. The greater the difference, the more fuel will be consumed for heating or cooling.

ECM--Energy Conservation Measure. Can be no cost/low cost or retrofit, depending on cost of implementing measure. Usually refers to capital modification of equipment or a facility to reduce energy consumption.

EMS--Energy Management System. A system of devices to control and/or monitor energy consumption. May include one or all components of HVAC, lighting, refrigeration, food preparation and water heating. The systems vary greatly in complexity from simple timers to sophisticated computers.

HVAC--Heating, ventilation and air conditioning systems.

ICP--Institutional Conservation Program. This is a federal matching grants program to provide monetary assistance and incentive to public and private non-profit institutions in the area of energy conservation. This is a U.S. Department of Energy program administered by the Energy Division of the Louisiana Department of Natural Resources.

kilowatt--A rate of electric power consumption, often applied to demand.

KWH--Kilowatt-hour. A measure of electric power consumed equal to the use of 1,000 watts in one hour.

MCF--One thousand cubic feet. The unit of measurement often applied to natural gas. Example: 10 MCF equals 10,000 cubic feet.

Retrofit--Redesign and modification of equipment or a structure, generally involving substantial financial investment. When compared with low-cost/no-cost modifications, retrofit is much more expensive.

CHAPTER 2

REVIEW OF LITERATURE

Energy Legislation

The most comprehensive national energy policy act ever to be passed in the U.S., HR 776, was enacted by the 102nd Congress during its second session in 1992. The purpose of the act was to establish a comprehensive national energy policy that "gradually and steadily increases U.S. energy security in cost-effective and environmentally beneficial ways" (United States Congress, 1992, p. 132). Although the energy policy affected virtually every aspect of society, Title I-Energy Efficiency, Subtitle A-Buildings, of the Act, referred to commercial buildings, which includes schools. Title I, Subtitle A required states to update commercial building codes which affect the energy efficiency of buildings. The Act mandated that commercial buildings must meet or exceed the requirements of ASHRAE standard 90.1-1989 for energy efficiency.

In 1978, Congress enacted the National Energy Conservation Policy Act. As a result of that legislation, schools and hospitals nationally received federal financial assistance for energy retrofits through a program referred to as the 'Schools and Hospitals Program' or the 'Institutional Conservation Program' (ICP). The Institutional Conservation Program is administered by the U. S. Department of Energy and provides energy audits and 50% matching grants for detailed energy analyses and for the installation of energy-saving

capital improvements to educational and health institutions (U.S. Department of Energy, 1984). Between 1978 and 1986, the ICP program awarded over $655 million in grants recognizing projects in nearly 50,000 public and private non-profit K-12, college and hospital buildings (Williamson, 1986; Smith, 1986). In 1988, the ICP program awarded over $32 million to 1,747 schools and hospitals for retrofit projects. Louisiana received $520,000 of the 1988 total, for a cumulative total of $5.8 million since the program's inception (U.S. Department of Energy, 1988).

Although not energy legislation per se, but a regulation or standard having a substantial impact on energy use in school buildings, ASHRAE 62-1985 is the only standard available for a healthy environment in commercial buildings. This standard increased the amount of outside air to be allowed into the building. The Department of Energy (cited in American Association of School Administrators, 1992) anticipated that while this standard improves indoor air quality, it also increased energy consumption by at least 20% or $1.5 billion because this outside air must be conditioned when it is brought indoors.

Louisiana's Economy as it Relates to Education

Louisiana faced a shortfall in its FY 1994 state budget of nearly $700,000,000 (Scott, Richardson & Jamal, 1992). Lawmakers sought ways to reduce spending and raise revenues to offset the shortage. Much controversy arose in the state regarding which state agencies should absorb

the spending cuts proposed by the Legislature. Many agencies are protected from budget cuts because they receive what are termed 'dedicated' funds. This placed the burden on a few agencies, such as higher education, because approximately 72% of the state's general fund consisted of dedicated funds (Myers, 1992a).

Because of the Minimum Foundation Program, commonly known as MFP, until 1993, Louisiana's elementary and secondary education system has been protected from budgetary cuts by the constitution with dedicated funds. However, a 1992 Constitutional Convention sought to change the constitution to allow the Legislature to cut state funding to all state agencies, including elementary and secondary education, by up to 10% (Myers, 1992b). This proposal created controversy among the state's educational leaders. Louisiana's educational system has been termed by some as a 'sacred cow' (Myers, 1992a). However, with the economy on the decline, the $1.8 billion funding for the state's educational system in 1993, which constituted about 40 percent of the $4.4 billion state general fund, was scrutinized and criticized. University of New Orleans economist Timothy Ryan reported to Myers (1992a) that when the provision was written into the 1973 constitutional convention to protect education from budget cuts, the state was enjoying the dividends of the oil boom. That situation has changed dramatically, with oil revenues dropping from a high of $1.7 billion to $650 million in the fall of 1992. Thus, Ryan purported, "the time has come for a

change" (p. 1-A). Ryan suggested that the change might allow local school districts to accept more responsibility for generating revenues for their own support, thus alleviating some of the burden on the state budget.

School Revenues

A 1992 study by the National Center for Education Statistics (Johnson, 1992) reported nationwide revenues for public education in 1990 to be $207.6 billion. Of this amount, state and local governments typically provide over 90%. The federal government share is relatively small, often less than 10%, and it continues to decline (National Education Association, 1991a). In 1979 the state share of funding rose above the local share for the first time in history and it is anticipated that this trend will continue, with states providing a larger share of the funding and federal funds becoming even more scarce (National Center for Education Statistics, 1992).

Johnson's study reported that Louisiana had $3,058,293,000 in revenues for education for FY '90. Fifty-six percent of the revenues was provided by state government, 34% by local government and 10% by the federal government. The state provided 3% more revenues in FY '90 than in FY '89. A 1992 news story in the Baton Rouge Advocate reported that while state funding for public education increased 35.8% from 1987 to 1991, enrollment actually decreased from 774,356 to 769,994 ("Vote for CC/92," 1992).

In 1990-91, Louisiana ranked 43rd in public school revenues per pupil at $4,396. Per pupil revenues nationwide ranged from $9,447 to $3,352, with a mean of $5,811. The state ranked 16th in the percent of revenues from state government, 36th in the percent of revenues from local government and 6th in the percent of revenues from the federal government. The mean percent of support from state governments was 48.9%. In 1990-91 public education in Louisiana received 56.5% of its support from the state. The mean percent of support received from local governments nationwide was 44.9%; Louisiana received 33.7% of its support from local government in 1990-91. Nationwide, the mean percent of revenues received from the federal government was 6.2%; Louisiana received 9.9% in 1990-91 (National Education Association, 1991b).

School Expenditures

In 1990, nationwide expenditures for public education were $187.4 billion (Johnson, 1992). Per pupil expenditures ranged from $2,832 to $8,518. The average total expenditure per pupil was $4,960. Of this amount, $2,884 was spent on instruction, $1,678 was spent on support services which includes operations and maintenance staff and energy expenditures, and $221 was spent on non-instructional staff including administrators.

It was predicted in a recent report that expenditures for public education will continue to rise (Hussar, 1992). The report prepared for the

National Center for Education Statistics projected that per student expenditures would rise nearly $1,000 in the next 10 years. The decade from 1980 to 1990 showed a 33% increase in overall student expenditures and an additional 20% increase is predicted between 1991 and 2001. A 1991 report by the National Education Association revealed expenditures per pupil increased 5.2% from the 1989 school year to the 1990 school year.

In Louisiana in FY 1990, total expenditures for education amounted to $2,802,793,000 (Johnson, 1992). Of this amount, 58.5% was spent for instruction, 32.1% for support services and 8.4% for non-instruction, including administration.

Louisiana ranked 36th when compared with the other states on current expenditure per pupil in average daily attendance (National Education Association, 1991b). In 1990-91, Louisiana spent approximately $3,760 per pupil on public education. Nationwide, expenditures ranged from $8,518 to $2,832.

Public schools throughout the country are locked into rigid budgets which are tied to previous legislative appropriations, property taxes and budget review procedures, and Louisiana is no exception. Limited flexibility leaves administrators no option but to cut educational programs and services, including maintenance, to absorb higher costs (American Association of School Administrators, 1992). Revenues continue to drop while climbing enrollments place greater demands on school dollars.

Energy Consumption and Expenditures in Schools

In 1990-91, school administrators reported that the nation's school energy bill was up $490 million. It was predicted that public schools would spend $7.4 billion for energy in 1992. Between 1989 and 1992 school utility costs increased more than 18% Administrators reported that, despite the rise in energy consumption and utility costs, 44.4% of school districts did not have an energy management program in place (American Association of School Administrators, 1992).

In 1984, schools throughout the country were paying nearly $5 billion more for energy than they did in 1974. Per pupil expenditures for energy grew 600 to 750% during the 10 year period (Hansen & Associates, Inc., 1984). It is anticipated that school energy costs will increase dramatically in the future. A 1984 report by the U.S. Department of Energy cited in School Business Affairs (Hansen & Associates, Inc., 1984) predicted that most schools would spend nearly $900 per student annually for energy by the year 2000. The dramatic rise in expenditures will be primarily due to an increase in fuel prices. Natural gas was expected to show the greatest increase in price. Conservative estimates were that the price would increase by at least 80%. This is of critical importance to schools, as natural gas is the fuel most used by schools. Hansen and Associates, Inc. (1984) expected the burden of increasing energy costs to be greatest on schools in the South and

Southwest where consumers were heavily dependent on natural gas for their energy supply.

Rising fuel prices and President Clinton's proposed energy policy could have major effects on energy expenditures in Louisiana. The state was second only to Alaska in its per capita consumption of energy in 1987. Also in 1987, Louisiana ranked 6th in total energy consumption in the country, consuming some 3,410 trillion BTUs. The state ranked 3rd in consumption of natural gas, 5th in consumption of petroleum, 15th in consumption of electricity and 31st in consumption of coal. In 1987, Louisiana's commercial sector, which includes schools, ranked 18th in the country in consumption of energy (World Eagle, Inc., 1990).

Literature documenting past school expenditures on energy is sparse. Gardener (1984) reported that in 1973, schools used approximately 12.5% of their discretionary budget for energy. By 1976, the portion of the general budget used for energy had risen to 35% and was rising. A report by the Federal Energy Administration (1977) revealed that the typical school district in the United States spent $29.77 per pupil for fuel in 1974-75. This was a 48.3% increase from the 1972-73 school year. Region 6, which includes Louisiana, realized a median energy cost of $20.89 per pupil during the 1974-75 school year. A study of average energy costs per pupil in North Carolina compiled for selected years from 1969-78 indicated energy costs increased almost 322% during that period (Canipe, 1979). A 1983 report revealed that

school districts in the state of New Jersey expended twice as much on heating and three times as much on other utilities as they expended on textbooks (Wiles, 1983).

A 1992 study by American Schools and Universities revealed school districts nationwide spent less on maintenance and operations per pupil during the 1991-92 school year than in previous years (Agron, 1992). The 21st Annual Maintenance and Operations Cost Study analyzed maintenance and operations costs in dollars per student and dollars per square foot in the country. Fifteen percent of the public school districts in the nation participated in the survey. School districts in Arkansas, Louisiana, New Mexico, Oklahoma and Texas which make up Region 6 reported spending $99.63 per pupil on fuels and electricity. Region 6 also had the highest percent (11.79%) of net current expenditures in maintenance and operations. Seventy-seven cents per square foot was spent on fuel and electricity in the region.

The follow-up 1993 American Schools and Universities study reported school districts in Region 6 spending $101.82 per pupil and $.75 per square foot on energy (Agron, 1993). The following conclusions related to maintenance and operations and energy use were drawn from the 22nd annual cost study and reported by Agron: (1) Energy costs are on the rise; (2) School districts are conducting more in-house training of staff and contracting out less maintenance and operations work; (3) Salaries of maintenance and

operations personnel are decreasing; and (4) There has been a dramatic increase in both the cost for equipment and maintenance supplies and the number of square feet per custodian during 1992.

Maintenance and Operations

"Your energy budget is really a pot of money you choose to give to the utility companies and fuel suppliers. I say 'choose', because you could, through improved energy management, elect to keep some of that money for educating students" (Rose, 1984, p. 39). Rose purports that the potential does exist for saving energy dollars in schools, if administrators choose to do so. A critical component of energy management is maintenance and operations. Maintenance and operations includes all of the tasks associated with the upkeep and cleaning of buildings, as well as the repair and upkeep of equipment, electrical wiring and plumbing. Total maintenance and operations expenditures in a school budget generally includes salaries, fringe benefits, overhead, supplies, equipment, energy, utilities, and outside contracts for the maintenance and custodial departments (Agron, 1993).

The 22nd annual maintenance and operations cost study conducted by American Schools and Universities determined that school districts nationwide were allocating fewer dollars to maintenance and operations. The 1993 study indicated school districts were spending a total of $477.62 per student on total maintenance and operations, including energy costs. This figure represented a 2.4% decrease over the 1992 expenditure. The study also

concluded that maintenance and operations represented a significantly smaller percentage of district net current expenditures. In 1993, maintenance and operations comprised 9.03% of net current expenditures, down 15.8% over the previous year (Agron, 1993). Net current expenditure was defined by Agron as the total district expenditures, including teacher salaries, minus the cost of transportation, capital outlay and debt service.

According to a 1992 survey of school administrators, nearly 5,000,000 American public school students attended classes in substandard buildings (American Association of School Administrators, 1992). The study revealed that 74% of the nation's schools were built prior to WW II or during the 1950s-60s era of cheap construction. They were constructed to meet the educational needs of baby boomers. The period in which they were built was also a period when energy was plentiful and inexpensive (Gardener, 1984; Nordeen, 1983); consequently, little consideration was given to the energy efficiency of the designs. Today, as fossil fuels are being rapidly depleted and energy costs are soaring, energy use is being more closely scrutinized in most sectors of society. Energy efficiency in all buildings is critical. Additionally, many school facilities were built with inefficient heating systems because the initial financial investment was low. Vander Vliet (1993) reported long-term savings usually results from investments in upgraded HVAC systems.

Over 12% of the school buildings are considered inadequate with many being unsafe or unhealthy. The primary culprit is lack of preventative

maintenance on both equipment and facilities. Reduction in maintenance procedures and maintenance personnel resulted in deteriorating buildings and HVAC systems, which in turn consume more energy and use up a larger portion of the operating budget (Nordeen, 1983).

Why has preventative maintenance not been performed? Lack of manpower and finances are the primary reasons. School systems have been placed in financial straits by mandated federal regulations, such as asbestos abatement, clean air requirements and handicapped accessibility, each of which depends on already stressed school budgets for funding.

Wiles (1982) reported that administrators were feeling pressured to choose between energy and education and were having a difficult time making the choice--each is dependent on the other. Wiles reported that maintenance and operations is the school budget category that suffers most when budget dollars are tight (Wiles, 1982). Public education is the only entity which cannot pass on the increased cost of energy to its users. Others can raise prices or charge for services--public schools cannot. School systems are examining cost avoidance as one means of offsetting rising energy prices (Wiles, 1982). Cost avoidance involves using money saved through energy conservation to pay the higher energy costs.

The state of disrepair in public school facilities has a tremendous impact on the energy consumption of the facilities. Over 60% of school district administrators reported they lacked the funds to undertake changes in

maintenance procedures and modifications in HVAC systems needed to conserve energy (Federal Energy Administration, 1977). Building characteristics coupled with poor maintenance resulted in facilities which waste 25 to 50% of the energy used (Gardener, 1984). Principle obstacles to conserving energy are the age of the buildings, inadequate HVAC controls and air leaks in the buildings (Federal Energy Administration, 1977).

A poll of 72,000 teenage students conducted in 1991 by USA Today (cited in American Association of School Administrators, 1992) found that, if given more money for education, the first place students would invest the additional funds would be in maintenance and operations. They would increase the comfort of the educational facilities. Improving energy efficiency is one way to increase occupant comfort in schools. A joint report of the American Association of School administrators, the Council of the Great City Schools and the National School Boards Association released in 1983 revealed the average school district spent 6.7% of the annual budget on maintenance and capital improvements in 1982. Historically, this amount decreased steadily from 14.1% in 1920 to the 1982 low.

A 1988 report of the ICP program by the U.S. Department of Energy indicated that the largest energy conservation opportunities for schools were with control measures and the next largest savings could come from instituting mechanical system measures. Estimates of exactly how much money could be saved by implementing energy conservation practices in these

two areas in school systems varied. The determining factor was the level at which the school system chooses to get involved and how much they were willing to invest in the changes. Stephan (cited in Gardener, 1984) suggested that school districts could save 5 to 25% in energy expenditures by simply changing their method of operation in the school and an additional 25 to 35% with small capital improvements. A Department of Energy report cited in Rose (1985) suggested that $4 out of $5 in savings realized by grantees participating in ICP programs resulted from changes in people-related factors, not from investments in equipment.

The Louisiana Department of Natural Resources (1985) estimated that Louisiana schools could realize a savings of at least 10% of the total energy consumption with little or no significant expenditures, only a change in operating procedures. A 1982 national study of institutional and commercial buildings by the Office of Technology Assessment estimated that schools could realize a much higher savings with low-to-moderate cost retrofits. The average percent of savings realized by elementary schools in the study was 24% and, by secondary schools, 30%. Smith (1986) estimated that energy consumption and costs in schools could be reduced by up to 30% by investing in energy conservation measures which have a two-year or less payback. The American Association of School Administrators (1992) estimated that schools could save 25% or $1.85 billion per year through improved energy efficiency.

A 1981 study of 724 school districts receiving energy conservation measure grants under the National Energy Conservation Policy Act, Title III, Cycle 1 found school districts reducing energy consumption by 20.7% with a suggested payback on improvements of 4.8 years (Hansen & Associates, Inc., 1982). Herricks Union Free School District in New York reduced oil consumption by 34% and electrical consumption by 20% simply by making low cost modifications in the heating and ventilating equipment in the schools (Shreiber & Paige, 1976). The resulting energy savings 'paid back' labor plus material costs in less than one year.

For school systems that want to save even more dollars, the Institutional Conservation Program (ICP) offers additional opportunities (U.S. Department of Energy, 1984). The ICP was authorized by the National Energy Conservation Policy Act of 1978 and is administered by the U.S. Department of Energy (DOE). It provides energy audits and 50% matching grants for detailed energy analyses and for the installation of energy-saving capital improvements to schools and hospitals. Many school systems report substantial energy savings due to their involvement with the ICP program.

Administrators cited a lack of leadership in providing schools with facility guidance both on the federal level and on the state level as one reason it is so difficult to implement energy conservation and maintenance and operations measures in schools (American Association of School Administrators, 1992; Minning, 1987). They reported depending on no one

source for energy information to help them with energy-related problems. Approximately 20% depended on utility companies for information and another 20% relied on consultants. Almost 18% relied on information from their associates. The literature supported this dependence on information from associates by citing numerous papers presented at professional meetings of educators and administrators which addressed energy management program implementation (Association of School Business Officials of the U.S. and Canada, 1982; Lukco, 1981). An additional 17% of administrators depended on their state energy offices. Administrators reported receiving virtually no guidance from universities on energy-related matters.

Revenue Alternatives for Energy Management Programs

In spite of the desire by administrators to do something to improve the energy efficiency of their school facilities, there were some major barriers to implementing these cost saving measures. Lack of funds, financial need for educational programs and additional money required to meet environmental mandates, such as asbestos abatement, made dollars available for improving energy efficiency scarce (American Association of School Administrators, 1992). In the past, schools have relied heavily on their school general operating funds to finance energy improvements. Fifty percent have benefitted from state or federal grants and 20% have relied on utility rebates, bonds and performance contracts. In the future, it is anticipated that there will be a much greater reliance on private sector energy financing. As

Petroleum Violation Escrow grant funds made available to the states by DOE continue to decline, states will depend more on performance contracting. From 1987 to 1991, performance contracting increased from 10% to 19.4% (American Association of School Administrators, 1992).

The implementation of an energy management program requires varying amounts of revenues to be invested. The lack of revenues has, at times, kept schools from implementing energy programs. 'Alternative financing' has become the interest of those seeking to make energy improvements. Alternative financing refers to obtaining funds for energy conservation improvements from any source other than federal or state appropriations or local revenues obtained through the normal capital budgeting procedures (Rose, 1984, 1985).

Private sector funding manifests itself in several financing procedures. Alternatives include revenue bonds, municipal leasing, cost sharing, shared savings, third party or joint venture and general energy services contracts (Rose, 1985).

Shared energy savings as an option for self-generating revenues refers to enlisting the assistance of a professional engineering or energy management firm to implement an energy savings program (Rose, 1984). The dollars saved by the school are then 'shared' with the firm providing the technical assistance. Percentages shared differ with firms, but a 50-50 share is not uncommon. Rose cautioned administrators to be careful, investigate

options and select partners carefully in this venture. Because investing in professional energy management firms often requires an initial investment, Rose suggested that schools begin with small steps towards energy management on their own. Rose (1984) then suggested that dollars saved could be invested in capital improvements or to hire professional energy management consultants which could generate real energy savings in addition to financial savings.

Rose (1985) viewed alternative financing as having an impact on the capability of schools affording energy improvements. However, because the area is relatively new, financing alternatives have not been standardized and few guidelines are available. Therefore, Rose urged careful consideration of all options.

Model Energy Management Plans and Programs in Schools

Many states have implemented energy management programs in their educational systems that have worked quite well. Among them, there are many commonalities, and between them, many differences. Common threads that seem to run through many successful programs are receiving administrative commitment, establishing an energy policy, involving everyone in the school in the energy management program, conducting an energy audit to assess the situation and monitoring the progress of the program (Gardener, 1984; Zachar, 1985a, 1985b; LeMaster, 1983).

The Canadian School Trustees Association (1987) agreed that, in order for programs on energy conservation to function most effectively, cooperation and understanding from those within the buildings of the school system--teaching staff, non-teaching staff, students and the school board itself--must be achieved. Vance and Kieley (1984) claimed "significant reductions in energy use are possible, but can only be achieved when reduced energy consumption is clearly defined as a management goal and a program to accomplish that goal is implemented" (p. 22). Vance and Kieley further stated that "collecting data, evaluating alternatives, forecasting results, implementing action--in short, the familiar techniques of sound management--are what effective energy management is about" (p. 22).

Many successful energy management programs follow a basic management approach to programming. One process used is the Total Energy Management Process or TEM. This process involves the following phases: (1) initiation; (2) development; (3) implementation; and (4) evaluation. Specific steps involve obtaining administrative commitment, establishing an energy policy statement, appointing an energy coordinator, organizing an energy team, assessing the current energy usage status, determining goals and priorities, allocating resources to implement necessary changes, developing an accounting system, conducting energy audits, and training staff members (Minnesota State Department of Energy and Economic Development, 1983). School districts in Minnesota implemented TEM in a unified, planned approach

to reducing energy use and costs in individual schools and entire school districts in 1983. This included thorough energy accounting, operations and maintenance changes, modifications in building envelopes and energy-using systems, transportation management and the development of an energy education curriculum. Mankato School District realized over $200,000 in energy savings from 1976 to 1983 and Bagley School District saved over 25% on their heating bills. Anoka-Hennepin School District saved $350,000 during the 1981-82 school year. Minnesota School Districts raised energy consciousness among students, staff, faculty and administrators and made energy decision making a high priority with administrators.

A Salem, Oregon school district saved $70,000 per year by advocating flexibility in their energy management system (Stern, 1984). Steps taken to insure flexibility were establishing a weekly bidding system for fuel prices which reduced fuel costs from 10-20%; converting boilers to burn either coal or gas, depending on which is cheaper at the time; zoning of HVAC systems; and the installation of heat recovery systems, timers on equipment to offset peak loading and temperature controls on all thermostats. By beginning with energy management activities which had a short payback period, the school system was able to invest the savings in more costly activities that resulted in even larger energy savings.

Wiley (1988) described an energy management program implemented in the Akron, Ohio school district. Administrators reported that prior to the

energy management program, schools had operated on a 'bandaid and bailing wire approach' to repairs rather than practicing preventative maintenance. The program involved the creation of an energy management office which established a new approach to responsible energy use, a comprehensive approach to preventative maintenance, consistent operations practices and a commitment to maintaining the best learning environment possible for students. Utility costs in the district decreased about 30% between 1984 and 1988. Savings of over $2.5 million generated support among the general public for bond issues which enabled the school district to implement even more energy improvements. Escambia School District in Pensacola, Florida realized a savings of nearly $280,000 during the first year of a similar program (LeMaster, 1983).

In some areas of the country where temperatures reach extremes, school districts have implemented a four-day school schedule. The benefits of this schedule have been reduced gas consumption for buses by 22.5%, reduced bus maintenance costs by 18%, reduced electrical consumption by 23% and reduced heating fuel consumption by 7 to 25% (Gardener, 1984).

Other school districts in the country have sought additional means of saving energy in their schools. The Cecil County, Maryland Board of Education realized a 31% reduction in energy costs when it entered into a five-year guaranteed savings agreement with Johnson Controls (School Business Affairs, 1984). In guaranteed savings agreements, the contracted

company guarantees the school a certain amount in energy savings and returns any amount saved over and above the minimum to the school.

Energy Management Education

Training and interpersonal skills can greatly improve school maintenance and operations in school physical plants and reduce energy consumption (Kent, 1986). An Ontario school district found a decentralized energy management and education program to be most effective in reducing energy loss (Pond-Brevik, 1987). The decentralized program included a structured training and education program for all personnel, a plan for reinforcement of energy-related policies and the nurturing of an overall attitude that encourages involvement in the energy management program. Resource documents were used to integrate energy concepts into the curriculum. Physical plant changes, operational changes and control policy changes contributed to a 20% reduction in school energy use (Rankin, 1987).

Although the Ontario school district formulated its own successful energy management education program, some school districts may not have the resources available to conduct similar programs. Other agencies may be requested to provide assistance. Within each state in the U.S., state energy offices have long been the primary energy education entities and recognized experts in the field of energy education. In recent years, however, state energy offices in many states have become a division within another state department such as Natural Resources or Economic Development, as is the

case in Louisiana. As such, many energy offices lost some of their identity. The inclusion of the energy office with other departments is the result of decreased federal funding, and programs and staff have been reduced accordingly. Some have maintained public information programs supported through Energy Extension Service and other federally funded, state administered programs. For the most part, however, state energy offices are no longer in the business of public education, as the funds and staff are not available. Many states have eliminated the position of energy education specialist from their staffs and the duties have been assigned to other positions. The responsibilities inherent in the energy education specialist position are overlooked or overlap with others (Education Commission of the States, 1983). Louisiana's state energy office is housed within the Louisiana Department of Natural Resources as the Energy Division.

LCES, which is a branch of the LSU Agricultural Center, has been involved in energy education work since the 1960s. Since 1977, LCES has pooled its resources with DNR's Energy Division to assist citizens of the state to save energy dollars through numerous and varied educational programs. The audiences for energy conservation educational programs conducted by LCES have ranged from preschoolers to senior citizens, from low income families to bank presidents and from farmers and aquacultural producers to commercial and industrial owners and managers (Baker, 1992). Adoption rates of 92% have been recorded for recommended energy conservation

practices. LCES provides the manpower and expertise necessary to deliver the energy conservation education message to the citizenry. As educational energy programs were planned and conducted, great emphasis was placed on the needs of the clientele. LCES received two national awards presented by the U.S. Department of Energy and numerous state awards presented by DNR for innovative energy education programs in 1990 and 1991 (Baker, 1992).

The Cooperative Extension Service has long been recognized for its ability to present quality research-based, educational programs to its clientele (Rasmussen, 1989). The Louisiana Cooperative Extension Service has an office in each parish of the state with educational and facilitator capabilities that are not found in any other organization within the state. Networking with other state agencies, local governments, private businesses and utility companies allows LCES to establish extensive team efforts which improves the efficiency of programs being disseminated (Baker, 1992).

Because 4-H clubs are organized within most of the state's schools, local Extension agents have close working relationships with school administrators. A recent three-year cooperative effort between LCES and DNR resulted in over 300,000 fourth through twelfth grade students and 9,000 school faculty and staff members participating in energy conservation education programs (Acosta, 1992).

The LCES administrative structure features five districts, with an administrative unit in each district. Figure 1 graphically presents LCES

administrative areas of the state. Each area also has an area energy agent housed within the area. The area energy agents and two state office specialists are employed through an energy education contract with the Louisiana Department of Natural Resources. It is the job of the energy agent to conduct energy conservation education programs in the schools within their respective geographic areas (Louisiana Cooperative Extension Service, 1990).

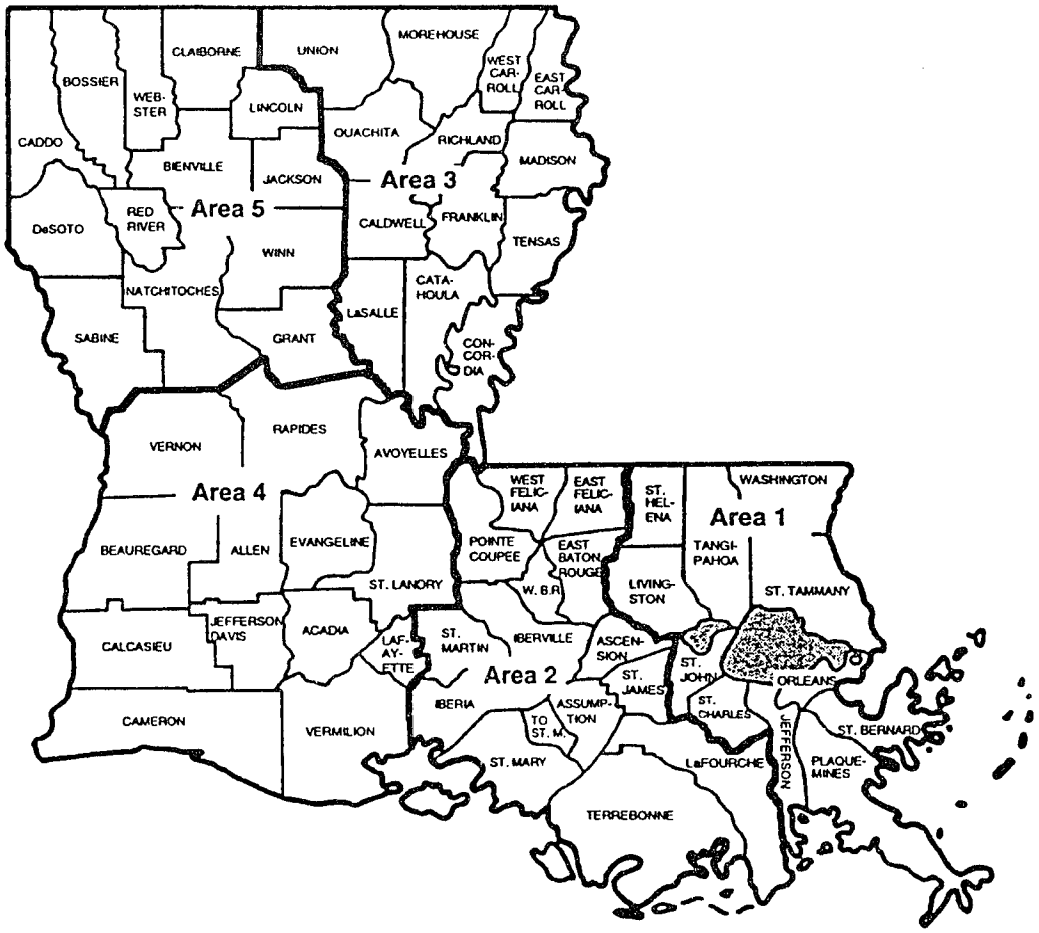

Figure 1. LCES Geographic and Administrative Areas

Summary and Research Model

With Louisiana's economy on the decline, the state's level of funding for public education has been criticized and scrutinized. State funds dedicated to public education comprise 40% of the state general fund (Myers, 1992b). In FY'90, 56% of Louisiana's revenues for public education came from the state, 34% from local governments and 10% from the federal government (Johnson, 1992). Although once protected by a constitutional provision with dedicated funds, Louisiana's public school districts stand to lose some of their state funding if proposals to change the state's constitution are approved (Myers, 1992b). As public school funds become threatened, school administrators must analyze their expenditures to determine where they might cut costs. One targeted area has been in maintenance and operations and energy expenditures (Hansen & Associates, Inc., 1984; Agron, 1992; 1993; Wiles, 1982).

The idea of energy conservation, which in the 1970s created images of long gas lines, rapid price hikes, deprivation and Mid East conflicts, has moved to a more mature conceptualization. School administrators presently view energy as a resource which should be managed like any other resource the school has available (Zachar, 1985a). To give further impetus to school officials to better manage their energy resources, U.S., HR 776, a comprehensive national energy policy act was passed in 1992 (United States

Congress, 1992). The Act required states to improve the energy efficiency of commercial buildings, including schools.

Substantial savings for schools in energy expenditures is projected from the implementation of maintenance and operations practices. Estimates are that savings ranging from 5 to 30% may be realized by instituting control measures, making minor changes in mechanical systems and performing maintenance on existing equipment (Gardener, 1984; U.S. Department of Energy, 1988; Gardener, 1984; Louisiana Department of Natural Resources, 1985; Office of Technology Assessment, 1982; Smith, 1986; American Association of School Administrators (1992).

A plan for energy management must be instituted for school districts to achieve a reduction in energy use and expenditures (Vance & Kieley, 1984; Canadian School Trustees Association, 1987; Wiley, 1988). It is suggested in the literature that the energy management plan follow a basic management approach (Minnesota State Department of Energy and Economic Development, 1983). The plan should include administrative commitment, establishing an energy policy, involving all persons at the school, conducting an energy audit to assess the energy use situation and monitoring the progress of the program (Gardener, 1984; Zachar, 1985a, 1985b; LeMaster, 1983).

Education of school personnel is critical to the success of an energy management program. Kent (1986), Pond-Brevik (1987) and Rankin (1987) report that training and interpersonal skills can greatly improve school

maintenance and operations in school physical plants and reduce energy consumption.

Educational programs should be designed to meet the differing needs of school personnel and school districts. The Louisiana Cooperative Extension Service has the faculty and resources available to assist school districts in designing and implementing comprehensive energy plans. LCES also is capable of evaluating the need for, designing, presenting and evaluating the educational programs to enhance energy management plans.

CHAPTER 3

METHODOLOGY

Design of the Study

The purpose of this study was to describe the status of energy use in Louisiana's public elementary and secondary schools. The objectives were to: (1) determine energy usage and energy expenditures on a per student and per square footage basis for Louisiana's 66 school districts and to determine the relationship between per student and per square foot expenditures; (2) compare the per square footage and per student expenditures for energy use in Louisiana with the U. S. regional averages; (3) compare school districts within the state to the identified state average; (4) prioritize Louisiana's 66 school districts in order of need for energy management assistance; (5) determine per square foot and per student costs for maintenance and operations; (6) determine the relationship between maintenance and operations expenditures and energy expenditures, and, (7) determine the importance of selected energy management concepts to be addressed in educational programs for school maintenance and janitorial personnel. The study is classified as descriptive survey research.

Population and Sample

There is one parish-wide public school district in each of Louisiana's 64 parishes. In addition, the cities of Monroe and Bogalusa have their own public school districts, resulting in a total of 66 public school districts in the state.

Louisiana's 66 public school districts are identified within LCES geographic areas in Figure 2. The target population for the study was the state's 66 public school districts. The sampling plan included 100% of the public school districts within the state; therefore, the study would be most appropriately classified as a census.

Figure 2. Louisiana's 66 Public School Districts within LCES Geographic Areas

Instrumentation

Attempts to locate a valid instrument with which to collect the desired data were unsuccessful. Therefore, the instrument used was designed by the researcher. Following a thorough search of the literature, the researcher, in consultation with LCES engineering and energy specialists, designed an appropriate instrument. A similar study conducted by American Schools and Universities (1992) served as a model for the instrument design. Additionally, information acquired from previously conducted LCES energy audits was used to complete the design of the instrument.

The instrument was validated by a panel of experts consisting of two LCES engineers specializing in building envelopes and HVAC equipment, two LCES energy specialists, four utility company representatives with extensive experience in auditing and energy management programs and a heating and air conditioning consultant.

A field test and evaluation of the instrument was conducted with three parish maintenance supervisors who did not participate in the actual study and a recently retired school superintendent. Following the field test, adjustments were made in the instrument to further clarify the information requested. Two items were added to the instrument and one item was eliminated. Where appropriate, examples of possible responses were added. Related to format, additional space was added for some responses and choices for responses were combined to be less specific.

Data were collected for the 1991-92 school year, the most recently completed school year for which data would be available in the school districts. Data collected included the number of schools and students in each district, the gross square footage of all buildings by age of the buildings, the total amount of money expended on utilities in each district on an annual basis and how this amount related to the overall budget, the budgeted amount for maintenance of buildings and grounds, the number of people on the parish maintenance staff, and current expenditures on outside maintenance and/or energy management contracts. Data were also collected regarding the total school system operations and maintenance budget, the monitoring of energy use, policies on energy use and energy management training provided and planned for school personnel. Respondents were asked to supply copies of job descriptions for parish maintenance personnel and written policies regarding operations and maintenance that affect energy consumption. A copy of the survey instrument appears in Appendix A.

Data Collection

It was determined that the key to the success of the study would be getting the questionnaire to the person who could most easily access the information required in the questionnaire. It has been observed that records regarding energy use in school districts are not consistent in format across the state (Louisiana Cooperative Extension Service, 1992). Based on comments and phone calls received from respondents, locating the data in some school

district offices required detailed searching of school records, even when the appropriate person received the instrument. In order to eliminate wasted time, LCES energy agents made preliminary personal contacts with each school superintendent in the state to discuss the study. During the initial contact with the superintendent, the area energy agents requested the names of the persons in the school system administrative offices who would most likely have access to the information requested on the instrument. In some cases, superintendents chose to receive the instrument themselves; in other cases, the supervisor in charge of maintenance and operations, the business manager or some other administrator was identified by the superintendent as the most appropriate respondent. A list of the most appropriate persons to receive the questionnaire was compiled from the energy agents' personal contacts with school superintendents. This list established the frame of the population.

The instrument was mailed to potential respondents. A cover letter, printed on LCES letterhead, accompanied the instrument. The letter encouraged a timely response from superintendents or their designee and was co-signed by the president-elect of the Louisiana School Superintendents' Association and the president of the Louisiana School Board Association, both of whom offered their full cooperation to the project, and to the researcher. The signatures of the two state professional association administrators was sought based on Gay's (1981) recommendation that having the endorsement of officers in professional associations may increase the response rate. The

letter explained the study and emphasized the potential benefits to be obtained by the school districts in Louisiana as a result of the study. A copy of the cover letter may be found in Appendix B. A self-addressed business reply mail envelope was included for responses. A copy of the questionnaire also was sent to every superintendent in the state for informational purposes.

Non-response Follow-up

According to Gay (1981), self-report studies such as those using questionnaires often suffer from lack of response. Because the information requested in the questionnaire might have had to be researched to some extent by the respondent, it was anticipated that even fewer questionnaires would be returned in a timely manner. A sound non-response follow-up plan was deemed critical. Ten days after the instrument was mailed, a reminder post card was sent to respondents thanking them for their timely response if they had already responded and reminding them to respond if they had not done so. A copy of the reminder post card is included in Appendix C. Two weeks after the reminder post card was sent, personal contacts by telephone and office visits were made by the LCES energy agents to the non-respondents in the school districts in their respective geographic areas. Also, an exhibit featuring the study and its potential impact on Louisiana schools was set up at the Louisiana School Board Association (LSBA) meeting held in Lafayette, LA. At the meeting, additional individual contacts were made with school superintendents and school board members to obtain support for the

study. Additional individual contacts were made by telephone and through office visits with superintendents and school board members after the LSBA meeting. This effort was made in an attempt to receive a 100% response so a complete profile could be obtained of the existing energy expenditure situation throughout the state.

Responses were received from 55 school districts, resulting in an 83% response rate for the study. Thirty-three responses were received following the first and second mailings. Twenty-two additional responses were received following the Louisiana School Board Association meeting and subsequent follow-up contacts. Table 1 lists the school districts for which responses were received.

Table 1

School Districts for Which Responses Were Received

Allen	Franklin	Plaquemines	Tangipahoa
Ascension	Grant	Pointe Coupee	Tensas
Assumption	Iberia	Rapides	Terrebonne
Beauregard	Iberville	Richland	Union
Bienville	Jefferson	Sabine	Vermilion
Bossier	Jeff Davis	St. Bernard	Vernon
Caddo	Lafayette	St. Charles	Washington
Caldwell	Lafourche	St. Helena	Webster
Cameron	LaSalle	St. James	West Baton Rouge
Concordia	Lincoln	St. John	West Carroll
Desoto	Livingston	St. Landry	West Feliciana
East Baton Rouge	Madison	St. Martin	Winn
East Carroll	Natchitoches	St. Mary	City of Bogalusa
East Feliciana	Orleans	St. Tammany	

In an effort to calculate a per student expenditure for energy in each of Louisiana's 66 public school districts, data were collected for the 11 school districts for which no responses were received from an annual statistical report of the Louisiana State Department of Education (1992). Data collected included the number of schools, number of students and total of utility costs for the 1991-92 school year. The data collected from the Louisiana State Department of Education report also were used to compare respondents to non-respondents.

Statistical comparisons using t-tests were conducted to determine if the school districts that responded to the questionnaire differed from those for whom data were collected from the State Department study. The two groups were compared on number of students, number of schools, total utility expenditures during the reporting period and per student expenditures for energy. Results of the t-test indicated that the two groups were significantly different on three of the four variables. It appeared that the group for which data were collected from State Department data had fewer schools with a smaller number of students and lower utility costs. The groups were not significantly different on per student expenditure for energy. Table 2 indicates the differences between the two groups on the variables identified.

Analysis of the Data

The first objective of the study was to determine energy usage and energy expenditures on a per student and per square footage basis for

Table 2

t-test for Difference in Self-Reported Responses and Responses From State Department of Education Report on Number of Schools, Number of Students, Total Utility Expenditures and Per Student Expenditures for Energy

Variable	N	Mean	SD	t-value	df	2 tailed probability
Number of schools						
Self-reported	55	23.33	25.09	-1.97	53.68	.054
Other	11	15.27	7.62			
Number of students						
Self-reported	55	12,975.16	16,400.25	-2.31	54.94	.025
Other	11	6,846.27	4,844.07			
Total utility expenditures						
Self-reported	55	$1,112,845.71	$1,255,772.01	-2.46	42.42	.018
Other	11	$ 567,295.36	$ 473,207.41			
Per student expenditures for energy						
Self-reported	55	$93.31	$23.77	-0.95	15.28	.359
Other	11	$86.46	$21.56			

Louisiana's 66 public school districts and to determine the relationship between per student and per square foot expenditures. Energy use and expenditures per square foot and per student were calculated from the data provided for each school district within the state. The energy use per student was calculated by dividing the total units (i.e. kwh, cubic feet, etc.) consumed in the school district for the 1991-92 school year by the number of students enrolled during that time period. The energy use per square foot was calculated by dividing the total units consumed by the reported gross square

footage of all buildings in 1991-92. The range, mean and standard deviation per student and per square foot are reported for each energy source consumed.

To calculate the expenditure for energy per square foot and per student, the amount of the school district budget spent on energy during the 1991-92 school year was divided by the gross square footage of the buildings and the number of students, respectively. Energy expenditures per student and per square foot are reported in groups with frequencies and percentages. The mean and standard deviation also are reported.

A Pearson's Product Moment Correlation was used to determine the relationship between energy expenditure per student and energy expenditure per square foot.

The second objective of the study was to compare the per square footage and per student expenditures for energy use in Louisiana with the regional averages. Regional averages were derived from the American Schools and Universities Cost Study (Agron, 1992). The mean per student expenditure for energy was calculated for each school district within the state. The mean per square foot expenditure for energy was calculated for each school district from which responses were received. The calculated means were compared with the regional average. The results are reported in ranges of standard deviations above and below the regional average.

Objective three was to compare the per square footage and per student energy costs for each of the 66 school districts to the statewide average energy expenditures. The calculated mean for each district was compared with the state mean to determine its deviation. The comparison is reported by number of standard deviations above and below the state mean.

Objective four was to prioritize the 66 school districts within Louisiana in order of need for energy management assistance, which was to be determined by per pupil and per square foot expenditures. Responding school districts ($\underline{n}=55$) were ranked from high to low on the basis of the calculated per square foot expenditures. All 66 school districts were ranked from high to low by per pupil expenditures for energy. School districts are ranked within LCES geographic areas. This ranking was used to prioritize school districts in order of the identified need for an LCES energy management program.

The fifth objective was to determine the cost per square foot and cost per student for maintenance and operations. This was calculated by totalling all expenses related to maintenance and operations from the survey, including expenses related to buildings and grounds; costs of maintenance equipment and supplies; and maintenance and operations payroll and personnel, and dividing by the number of students and number of square feet, respectively. School districts are grouped by expenditure levels and means and standard deviations are reported.

Objective six was to determine the relationship between maintenance and operations expenditures and energy costs. Pearson r correlation was used to determine the relationship between maintenance and operations expenditures per student and energy costs per students in the school districts. This correlation technique was selected because the two sets of data to be correlated were interval in nature. Gay (1981) reports that the Pearson r takes into account each and every value in both distributions. Gay further purports that it is also the most stable measure of correlation.

The seventh and final objective of the study was to identify concepts to be included in an educational program on energy management for school operations and maintenance personnel. From the list of fourteen concepts related to energy use and energy conservation included in the survey, a mean score was calculated for each concept for janitors and maintenance personnel individually. This mean score reflected the perceived degree of importance placed on including that concept in an educational program for maintenance personnel and janitorial/custodial staffs. Concepts then were ranked in order of indicated importance for inclusion in the educational program. A scale identifying levels of importance was established by the researcher for interpretive purposes. The mean and standard deviation are reported for each concept for each audience (i.e. janitors and maintenance personnel).

CHAPTER 4

FINDINGS

The purpose of this study was to describe the status of energy use in Louisiana's 66 public school districts. The findings are presented in this section. A general description of the responding school districts is presented first, followed by the findings for each objective.

General Information

Of the 55 school districts from which responses were received, 47% ($n = 26$) of the questionnaires were completed by maintenance supervisors. Thirteen percent ($n = 7$) were completed by school superintendents. The remaining 40% were completed by other school district employees including fiscal officers, business managers and assistant superintendents. Frequency of responses by job title is given in Table 3.

The number of schools in each of the 66 public school districts ranged from 3 to 125. The mean number of schools was 22 (standard deviation = 23.26). Sixty-eight percent ($n = 45$) of the school districts had fewer than 20 schools in their districts. A description of school districts by number of schools is presented in Table 4.

The number of students in each school district ranged from 1,484 to 82,000. The mean number of students per district was 11,954 (standard deviation = 15,243.29). Sixty-seven percent ($n = 43$) of the school districts

Table 3

Respondents by Job Title

Job title	f	%
Maintenance supervisor	26	47
Superintendent	7	13
Others		
Other facilities and maintenance personnel	7	13
Support/ancillary services personnel	7	13
Assistant superintendent	4	7
Business manager	4	7
Total	55	100

Table 4

Number of Schools in Louisiana Public School Districts

Number of schools per district	f	%
< 10	17	26
10-19	28	42
20-29	5	8
30-39	7	11
40-49	3	5
50-100	4	6
> 100	2	3
Total	66	100

Note. Mean = 22; standard deviation = 23.26

had fewer than 10,000 students. A description of school districts by number of students is in Table 5.

Table 5

Number of Students in Louisiana Public School Districts

Number of students	f	%
< 2,000	2	3
2,000-2,999	8	12
3,000-3,999	10	15
4,000-4,999	8	12
5,000-5,999	4	6
6,000-6,999	4	6
7,000-7,999	4	6
8,000-8,999	1	2
9,000-9,999	3	5
10,000-19,999	12	18
20,000-29,999	4	6
30,000-39,999	2	3
> 40,000	4	6
Total	66	100

Note. Mean = 11,954; standard deviation = 15,243.29

Fifty-five responses were received to the question regarding the gross square footage of all school buildings. A total of 78,996,380 square feet was reported for the 55 school districts. Total square footage for individual school districts ranged from 153,949 to 9,430,000. The mean square footage reported was 1,436,297 (standard deviation = 1,716,819).

The total square footage was reported by age of buildings for 51 school districts. Responses indicated a gross square footage of all buildings in these

districts of 74,504,998. The breakdown of square footage by age of buildings is indicated in Table 6. Twenty-six percent (n = 13) reported not having any buildings that were less than 10 years old. Of the 38 school districts with buildings less than 10 years old, the gross square footage ranged from 6,000 square feet to 766,796 square feet per school district. The mean square footage of buildings per district falling in this category was 171,020 (standard deviation = 200,764).

Table 6

Gross Square Footage of Louisiana School Buildings by Age of Building

Age of buildings	Number of districts	Mean	SD	Square footage	% of [a] total
< 10 years	38	171,020	200,764	8,722,023	12
11-20 years	36	230,095	269,132	11,734,828	16
> 20 years	51	1,057,826	1,589,829	53,949,147	72
Total				74,405,998	

[a]% of total square footage of buildings reported in the state

Twenty-nine percent (n = 15) reported no gross square footage of buildings between 11 and 20 years old. For the 36 districts which reported buildings in this age category, the total square footage was 11,734,828. The gross square footage of buildings 11 to 20 years old ranged from 4,155 square feet to 1,018,153 square feet per district. The mean square footage

of buildings which were in this category was 230,095 (standard deviation = 269,132).

All 51 school districts had buildings which were over 20 years old. The gross square footage of those buildings ranged from 80,580 to 8,130,000, with the total square footage being 53,949,147. This figure represents approximately 72% of the total square footage in school buildings in the 51 districts reporting. The mean square footage of buildings over 20 years old was 1,057,826 (standard deviation = 1,589,829).

Fifty responses were received to the question regarding the gross square footage of buildings heated and cooled. The gross square footage of buildings air conditioned ranged from 97,215 to 6,000,000. The mean square footage of buildings cooled per district was 1,278,900 (standard deviation = 1,334,473). The total square feet heated for the fifty school districts ranged from 176,324 to 9,430,000. The mean square footage of buildings heated per district was 1,558,797 (standard deviation = 1,835,771).

The total amount spent on utilities, including electricity, natural gas, water and propane, for the 1991-92 school year by the 66 public school districts was $67,446,763. The expenditures by individual school districts ranged from a low of $93,669 to a high of $5,895,557. Sixty-eight percent ($n = 45$) of the individual school districts fell below the mean expenditure of $1,021,921. The total energy expenditure by school districts is reported in Table 7.

Table 7

Energy Expenditures Per School District

Expenditure	f	%
< $250,000	7	11
$250,000-$499,999	24	36
$500,000-$999,999	14	21
$1,000,000-$1,499,999	10	15
$1,500,000-$1,999,999	3	5
$2,000,000-$3,999,999	5	7
> $4,000,000	3	5
	66	100

Note. Mean = $1,021,921; standard deviation = $1,777,504

Thirty-eight responses were received regarding who received copies of utility bills at the district and school levels. At the district level, it was reported that 89% (n = 34) of fiscal managers receive copies of utility bills. Forty-seven percent (n = 18) of maintenance supervisors and 39% (n = 15) of superintendents see individual bills. Fifty percent (n = 19) indicated that no one at the school received copies of utility bills on a monthly basis. Of the 50% that reported sending copies of utility bills to the individual schools, 95% (n = 18) reported that those bills were sent to the principals of the schools.

Fifty-five responses were received regarding the monitoring of utility bills at the district level. Seventy-five percent (n = 41) indicated that utility bills were evaluated and monitored on a monthly basis by school district personnel.

Thirty-eight responses were received regarding the monitoring of utility bills at the school level. Sixty-three percent (n = 28) reported that monthly bills were not evaluated at the schools, 32% (n = 12) reported that bills were evaluated monthly and 5% (n = 2) did not know if they were evaluated.

The total of all school board expenditures, excluding capital outlay, debt service and transportation for the 50 school districts responding to this question was $3,050,718,771. Expenditures per school district ranged from $451,586 to $947,700,950. The mean expenditure per district was $61,014,375 (standard deviation = $19,813,898).

Objective 1

The first objective of the study was to determine energy usage and energy expenditures on a per student and per square footage basis for Louisiana's 66 public school districts and to determine the relationship between per student and per square foot expenditures. The consumption of energy on a per student basis for electricity, natural gas, propane and water for school districts responding is reported in Table 8. Twenty-four school districts reported consumption of electricity in measurable units, while 22 reported consumption of natural gas. Three districts reported use of propane as an additional energy source.

The per square footage consumption for the same energy sources is reported in Table 9. Where necessary, figures have been converted to common terms for ease of comparison. It should be noted that the responses

Table 8

Energy Consumption per Student

Source/unit	n	Range	Mean	SD
Electricity KWH	24	349.20-2,489.57	911.70	440.34
Natural gas CCF	22	3.79-532.89	71.16	119.03
Propane CCF	3	1.91-10.24	.31	1.54
Water CF	19	0.00-8,785.54	1,227.55	2,412.88

Table 9

Energy Consumption per Square Foot

Source/unit	n	Range	Mean	SD
Electricity KWH	24	2.16-14.81	6.740	2.710
Natural gas CCF	22	.03-5.52	.653	1.230
Propane CCF	3	.01-.08	.002	.012
Water CF	19	0.00-59.79	9.580	17.580

reporting no water consumption also indicated that they had private wells and did not monitor consumption. It also should be noted that the number of

responses received to the question regarding energy consumption was low, with fewer than one-half of the 55 districts responding.

Energy expenditures on a per student basis were calculated for each of the state's 66 public school districts. For the 11 school districts that did not respond to the questionnaire, data regarding school district expenditures for utilities were collected from the Louisiana State Department of Education's Annual Financial and Statistical Report, Part IIA for the 1991-92 school year (Louisiana State Department of Education, 1992).

Per student expenditures for utilities ranged from $52.27 to $159.05 for the state's 66 school districts. The mean per student expenditure was $92.17 (standard deviation = $23.40). Forty-two school districts (64%) reported expenditures less than $100 per student. One school district reported energy expenditures of over $150 per student. Energy expenditures per student for the 66 school districts are reported in Table 10.

Table 10

Energy Expenditure per Student

Expenditure	f	%
< $75.00	16	24
$75.00-$99.99	26	39
$100.00-$124.99	19	29
$125.00-$149.99	4	6
> $150.00	1	2
Total	66	100

Note. Mean = $92.17; standard deviation = $23.40

Energy expenditures per square foot are reported in Table 11 for the 55 school districts responding. Expenditures ranged from $.27 to $1.26 per square foot. The mean energy expenditure was $.74 per square foot (standard deviation = $.17). Fifty-one percent (n = 28) of the school districts responding had energy expenditures below the mean. Two school districts reported energy expenditures of over $1.00 per square foot.

Table 11

Energy Expenditure per Square Foot

Expenditure	f	%
< $.60	9	16
$.60-$.74	19	35
$.75-$.89	17	31
$.90-$.99	8	15
> $1.00	2	4
Total	55	100

Note. Mean = $.74; standard deviation = $.17
Responses were not received for 11 school districts.

The relationship between per student and per square foot expenditures was examined. The calculated correlation coefficient of r = .48 implies a moderate association (Davis, 1971). Higher per student expenditures tended to be associated with higher per square foot expenditures.

Objective 2

The second objective of the study was to compare the per square footage and per student expenditures for energy use in Louisiana with regional

averages. Regional averages on a per square footage and per student basis were reported in the 1992 American Schools and Universities maintenance and operations cost study. On the average, school districts in Region 6, which includes Arkansas, Louisiana, New Mexico, Oklahoma and Texas, spent $.77 per square foot on utilities. The mean expenditure for Louisiana was $.74 (standard deviation = $.17). Because the standard deviation of the sample in the regional study was not available, the standard deviation of this sample was used to estimate the standard deviation of the regional data. As is indicated in Table 12, of the 55 school districts in Louisiana for which responses were received, 9% (n = 5) reported expenditures more than one standard deviation above the mean. Nine districts (17%) had expenditures more than one standard deviation below the regional average.

Table 12

Comparison of Louisiana per Square Foot Energy Expenditures with Regional per Square Foot Expenditures

Range	f	%
< $.43 (2+ SD below)	2	4
$.43-$.59 (1-2 SD below)	7	13
$.60-$.76 (0-1 SD below)	21	38
$.77-$.93 (0-1 SD above)	20	36
$.94-$1.11 (1-2 SD above)	4	7
> $1.11 (2+ SD above)	1	2
Total	55	100

Note. Regional mean = $.77; state mean = $.74; standard deviation = $.17

The American Schools and Universities study indicated that schools in Region 6 were spending $99.63 per student on utilities. The mean expenditure for energy in Louisiana's public schools was $92.17 per student (standard deviation = $23.40). As is reported in Table 13, of the 66 school districts for which data were obtained, 40 districts (61%) had average student expenditures within one standard deviation above or below the regional average. Seven school districts (10.5%) reported expenditures more than one standard deviation above the regional mean and 19 (28.5%) reported expenditures more than one standard deviation below the mean. Once again, the standard deviation of the sample was used to estimate the standard deviation of the regional data.

Table 13

Comparison of Louisiana per Student Energy Expenditures with Regional per Student Expenditures

Range	f	%
< $52.83 (2+ SD below)	1	1.5
$52.83-$76.22 (1-2 SD below)	18	27.0
$76.23-$99.62 (0-1 SD below)	23	35.0
$99.63-$123.02 (0-1 SD above)	17	26.0
$123.03-$146.43 (1-2 SD above)	6	9.0
> $146.43 (2+ SD above)	1	1.5
Total	66	100.0

Note. Regional mean = $99.63; state mean = $92.17; standard deviation = 23.40

Objective 3

Objective three of the study was to compare per student energy costs for each of the 66 school districts to the statewide average energy cost. The mean per student expenditure for energy in Louisiana's 66 school districts was $92.17 (standard deviation = $23.40). A comparison of district per student expenditures to the state average is reported in Table 14. Eleven school districts (17%) reported expenditures more than one standard deviation above the state mean for utilities on a per student basis. Seventy-one percent (n = 47) reported expenditures within one standard deviation above or below the mean for the state. Eight school districts (12%) reported expenditures more than one standard below the mean.

Table 14

Comparison of Louisiana School Districts' per Student Energy Expenditures with State Average

Range	f	%
< $45.37 (2+ SD below)	0	0
$45.37-$68.76 (1-2 SD below)	8	12
$68.77-$92.16 (0-1 SD below)	30	45
$92.17-$115.56 (0-1 SD above)	17	26
$115.57-$138.97 (1-2 SD above)	7	11
> $138.97 (2+ SD above)	4	6
Total	66	100

Note. State mean = $92.17; standard deviation = $23.40

The statewide mean for energy expenditures per square foot in the 55 Louisiana public school districts reporting for 1991-92 was $.74 (standard deviation = $.17). A comparison of district per square foot expenditures is reported in Table 15. Ten school districts (18%) reported expenditures more than one standard deviation above the state average for energy on a per square foot basis. Sixty-nine percent (n = 38) reported expenditures within one standard deviation of the mean, either above or below. Two districts had expenditures more than two standard deviations above the state average.

Table 15

Comparison of Louisiana School Districts' per Square Foot Energy Expenditures with State Average

Range	f	%
< $.40 (2+ SD below)	2	4
$.40-$.56 (1-2 SD below)	5	9
$.57-$.73 (0-1 SD below)	30	36
$.74-$.90 (0-1 SD above)	18	33
$.91-$1.08 (1-2 SD above)	9	16
> $1.08 (2+ SD above)	1	2
Total	55	100

Note. State mean = $.74; standard deviation = $.17

Objective 4

The fourth objective was to prioritize Louisiana's 66 public school districts in order of need for energy management assistance. This objective was accomplished by examination of per pupil and per square foot

expenditures for energy. Louisiana's 66 school districts are listed in descending order of per student expenditures for energy for the five Extension areas in Tables 16, 17, 18, 19 and 20. Rank in state based on per student expenditure and rank in state based on per square foot expenditure are also reported. The school districts listed first in each table are those with the highest per student expenditures for energy, and therefore are designated to have the greatest need for energy management assistance to cut energy expenditures.

Table 16

LCES Area 1 List of Louisiana School Districts in Descending Order of per Student Expenditures for Energy

District[a]	Per student	Rank in state	Per sq. ft.	Rank in state
1-A	$141.74	3	$ .98	3
1-B	$103.03	20	$ .85	15
1-C	$ 94.00	26	$ .91	10
1-D	$ 93.62	27	$ .88	12
1-E	$ 84.68	37	$ .93	6
1-F	$ 77.57	44	$ .66	36
1-G	$ 76.84	45	$ .76	26
1-H	$ 71.90	53	$ .63	42
1-I	$ 69.95	55	◆	◆
1-J	$ 66.45	60	$ .60	46
1-K	$ 61.94	64	$ .64	40
1-L	$ 52.27	66	$ .61	44

[a]School districts have been coded to assure anonymity.
◆ indicates that information was not available to make this calculation.

Table 17

LCES Area 2 List of Louisiana School Districts in Descending Order of per Student Expenditures for Energy

District[a]	Per student	Rank in state	Per sq. ft.	Rank in state
2-A	$159.05	1	$1.03	2
2-B	$140.36	4	$ .92	8
2-C	$137.00	5	$ .27	55
2-D	$105.44	16	$ .63	42
2-E	$104.48	19	$ .89	11
2-F	$ 91.59	29	$ .68	32
2-G	$ 85.32	36	$1.26	1
2-H	$ 81.52	41	$ .71	29
2-I	$ 75.60	48	$ .67	33
2-J	$ 75.45	49	$ .51	52
2-K	$ 75.39	50	$ .74	28
2-L	$ 73.04	52	$ .67	33
2-M	$ 70.64	54	$ .64	40
2-N	$ 62.54	63	$ .52	50

[a]School districts have been coded to assure anonymity.

Objective 5

Objective five was to calculate the expenditure per student and the expenditure per square foot for maintenance and operations in Louisiana's public school districts. Maintenance and operations costs included total payroll for custodians and maintenance personnel, cost of outside energy management and/or maintenance contracts, and the cost of maintenance equipment and supplies not included in an outside maintenance contract.

Total maintenance and operations expenditures for the 53 school districts from which responses were received was $113,652,591. When observing individual school districts, total maintenance and operations

Table 18

LCES Area 3 List of Louisiana School Districts in Descending Order of per Student Expenditures for Energy

District[a]	Per student	Rank in state	Per sq. ft.	Rank in state
3-A	$124.83	6	$ .85	15
3-B	$123.56	7	$ .88	12
3-C	$110.61	13	$ .84	17
3-D ◇	$110.50	14	◆	◆
3-E ◇	$104.79	18	◆	◆
3-F	$ 90.60	31	$ .76	26
3-G	$ 89.69	32	$ .38	54
3-H	$ 88.39	34	$ .61	45
3-I ◇	$ 82.37	39	◆	◆
3-J	$ 76.65	46	$ .59	47
3-K	$ 74.15	51	$ .65	38
3-L ◇	$ 69.30	56	◆	◆
3-M	$ 68.78	57	$ .46	53
3-N	$ 64.85	62	$ .52	51

[a]School districts have been coded to assure anonymity.
◇ indicates an Energy Profile was not returned for this parish. Data was collected from a State Department of Education report to determine per student expenditures.
◆ indicates that information was not available to make this calculation.

expenditures ranged from a low of $161,878 to a high of $17,214,449. The mean expenditure was $2,144,388 (standard deviation = $3,256,794).

Maintenance and operations expenditures of respondents are reported in Table 21. Twelve school districts (23%) reported expenditures less than $500,000 and five school districts (9%) reported expenditures more than $5,000,000 annually on maintenance and operations.

Table 19

LCES Area 4 List of Louisiana School Districts in Descending Order of per Student Expenditures for Energy

District[a]	Per student	Rank in state	Per sq. ft.	Rank in state
4-A	$145.80	2	$ .79	21
4-B	$122.47	8	$ .94	5
4-C	$112.97	12	$ .86	14
4-D	$104.82	17	$ .93	6
4-E	$102.53	21	$ .82	18
4-F	$100.87	23	$ .78	22
4-G	$ 97.39	25	$ .77	25
4-H	$ 89.43	33	$ .67	33
4-I	$ 79.62	43	$ .78	22
4-J	$ 68.78	58	$ .66	36
4-K◇	$ 66.98	59	◆	◆
4-L◇	$ 65.35	61	◆	◆
4-M◇	$ 54.95	65	◆	◆

[a]School districts have been coded to assure anonymity.
◇ indicates an Energy Profile was not returned for this parish. Data was collected from a State Department of Education report to determine per student expenditures.
◆ indicates that information was not available to make this calculation.

Maintenance and operations payrolls for the 55 school districts from which responses were received ranged from $76,363 to $13,994,688. The mean for the respondents was $1,765,019 (standard deviation = $2,785,553). Statewide, respondents spent $97,076,084 on payrolls for maintenance and operations employees. Per school district maintenance and operations payrolls expenditures are reported in Table 22. Sixty-three percent (n = 35) of the school districts spent less than $1,000,000 on maintenance

Table 20

LCES Area 5 List of Louisiana School Districts in Descending Order of per Student Expenditures for Energy

District[a]	Per student	Rank in state	Per sq. ft.	Rank in state
5-A	$120.83	9	$ .98	4
5-B◇	$119.02	10	◆	◆
5-C	$115.61	11	$ .92	8
5-D	$110.16	15	$ .78	22
5-E◇	$101.31	22	◆	◆
5-F◇	$100.85	24	◆	◆
5-G	$ 92.61	28	$ .59	47
5-H	$ 91.07	30	$ .80	19
5-I	$ 85.79	35	$ .55	49
5-J	$ 83.95	38	$ .71	29
5-K	$ 81.83	40	$ .69	31
5-L	$ 81.01	42	$ .80	19
5-M	$ 76.61	47	$ .65	38

[a]School districts have been coded to assure anonymity.
◇ indicates an Energy Profile was not returned for this parish. Data was collected from a State Department of Education report to determine per student expenditures.
◆ indicates that information was not available to make this calculation.

and operations payrolls during the 1991-92 school year. Of the six school districts who reported expenditures over $4,000,000, two districts (3%) reported spending more than $10,000,000 on maintenance and operations payrolls.

A further breakdown of maintenance and operations payrolls for the 55 school districts is reported in Table 23. A total of 4,502 janitors and custodians were employed by the school districts who responded. Two-thirds of those employed were employed on a full time (11 or 12 month)

Table 21

Total Maintenance and Operations Expenditures per School District

Expenditure	f	%
< $500,000	12	23
$500,000-$999,999	18	34
$1,000,000-$1,999,999	9	17
$2,000,000-$2,999,999	4	7
$3,000,000-$3,999,999	3	6
$4,000,000-$4,999,999	2	4
> $5,000,000	5	9
Total	53	100

Note. Mean = $2,144,388; standard deviation = $3,256,795

Table 22

Total Payroll for Janitors/Custodians and Maintenance Personnel per School District

Expenditure	f	%
< $500,000	19	34
$500,000-$999,999	16	29
$1,000,000-$1,999,999	8	15
$2,000,000-$2,999,999	4	7
$3,000,000-$3,999,999	2	4
> $4,000,000	6	11
Total	55	100

Note. Mean = $1,765,019; standard deviation = $2,785,553

appointment. Ninety-four percent of the 1,379 maintenance personnel employed by the responding school districts were employed 11 or 12 months

Table 23

Maintenance and Operations Payroll Analysis

	f	%	Avg. salary	Total payroll	% Total MO payroll
Janitors/custodians			**$12,646**	**$66,887,836**	**69**
Full time (11-12 months)	2956	66			
Full time (other)	590	13			
Part time	956	21			
Subtotal	4502	100			
Maintenance			**$17,660**	**$30,188,248**	**31**
Full time (11-12 months)	1301	94			
Full time (other)	3	1			
Part time	75	5			
Subtotal	1379	100			
Totals	**5881**			**$97,076,084**	**100**

in full time positions. A total of 5,881 personnel were employed in the area of maintenance and operations by the 55 school districts who responded.

The average annual salary for janitors and custodians ranged from a minimum of $8,000 to a maximum of $19,140, with a mean salary of $12,646 (standard deviation = $2,521). Average annual salaries for maintenance personnel ranged from $11,000 to $29,400, with a mean of $17,660 (standard deviation = $5,582).

Sixty-nine percent ($66,887,836) of the total maintenance and operations payroll was spent on custodial and janitorial salaries. Thirty-one

percent ($30,188,248) of the total maintenance and operations payroll was expended on salaries for maintenance personnel.

Fifteen school districts had outside maintenance and/or energy management contracts which totaled $4,151,375. As indicated in Table 24, seven school districts had outside maintenance contracts and eight had outside energy management contracts. Two school districts had a contract which included both energy management and maintenance. Total cost of outside contracts for each district ranged from $3,516 to $2,000,000. Maintenance contracts comprised 91% of the total expenditures on outside contracts. Contracts ranged in length from 12 months to 72 months. Eighty percent (n = 12) of the contracts were one year contracts.

Table 24

Cost and Number of Outside Energy Management and Maintenance Contracts

Type of contract	Number	Cost	% of total	Mean
Energy	8	$ 321,053	8	$ 40,132
Maintenance	7	$3,759,807	91	$537,115
Both	2	$ 70,515	1	$ 35,257
Total		$4,151,375	100	

For the school districts which did not have an energy management or maintenance contract, 79% (n = 33) of the respondents indicated that the school board was not considering an outside contract. The remaining 21%

(n = 9) indicated that the board was considering entering into an outside contract for maintenance and/or energy management services.

It was reported that school districts spent from $600 to $1,673,094 on maintenance equipment and supplies not included in any outside contracts. These items included such things as cleaning supplies, ladders, tools, refrigerants and air filters. The mean expenditure was $246,445 (standard deviation = $370,915).

Total maintenance and operations expenditures per student were reported for 53 school districts and ranged from $73.30 to $301.10. The mean per student expenditure calculated was $149.22 (standard deviation = $47.59). As is indicated in Table 25, 61% (n = 32) of the school districts for which responses were received, expended less than $150 per student on maintenance and operations in Louisiana.

Table 25

Per Student Expenditures for Maintenance and Operations

Expenditure	f	%
< $100	5	10
$100-$149	27	51
$150-$199	13	25
$200-$299	7	13
> $300	1	1
Total	53	100

Note. Mean = $149.22; standard deviation = $47.59

Maintenance and operations expenditures per square foot were calculated for 52 school districts. Expenditures ranged from $.38 to $2.33 per square foot. The mean per square foot expenditure was $1.22 (standard deviation = $.47). As indicated in Table 26, 75% of school districts expended less than $1.50 per square foot on maintenance and operations.

Table 26

Maintenance and Operations Expenditures per Square Foot

Expenditure	f	%
< $.75	7	13
$.76-$1.00	13	25
$1.01-$1.50	19	37
$1.51-$2.00	9	17
> $2.00	4	8
Total	52	100

Note. Mean = $1.22; standard deviation = $.47

Fifty-four responses were received regarding the question of whether or not the school district had written policies for the maintenance and operation of HVAC and refrigeration equipment, lighting, kitchens and building structures. As shown in Table 27, the large majority of school districts did not have written policies regarding maintenance and operations procedures. Well over 50% of respondents reported having no written policies regarding the operations and maintenance of the items in question. The area for which

Table 27

Written Policies Regarding Maintenance and Operations and Their Perceived Effectiveness

	Maintenance		Operations		Perceived effectiveness
	No f/%	Yes f/%	No f/%	Yes f/%	Mean
HVAC & refrigeration	36 67	18 33	38 70	16 30	3.5
Lighting	42 78	12 22	43 80	11 20	3.4
Kitchens	44 81	10 18	43 80	11 20	3.2
Building structures	45 83	9 17	46 85	8 15	3.1

Note. N = 54

the largest number of written policies was reported was HVAC and refrigeration and the smallest portion pertained to building structures.

Respondents were asked how effective they perceived the written policies to be. For those school districts which had written policies, the perceived effectiveness of the written policies is reported by means in the table. Mean perceived effectiveness ranged from 3.1 to 3.5 on a five point Likert-type scale, with one being perceived as not effective and five being perceived as very effective.

Objective 6

The sixth objective was to determine the relationship between maintenance and operations expenditures and energy costs. This was accomplished by calculating the correlation between the maintenance and operations expenditures per student and the total energy expenditures per student. The calculated correlation coefficient was $r = .01$ ($p = .93$). Therefore, no relationship was found between these measures.

In addition, the relationship between maintenance and operations expenditures per square foot and the total energy expenditures per square foot was examined. The calculated correlation coefficient was $r = .26$ ($p = .06$). According to descriptors established by Davis (1971), a coefficient of .26 is described as a low association. However, the coefficient was not statistically significant. Therefore, the variables were not found to be significantly related.

Objective 7

The study sought to determine the perceived importance of including selected concepts in an educational program on energy management for school maintenance and operations personnel. It was determined by the study that energy-related training is not provided on a regular basis for administrators, faculty, janitors, maintenance personnel or kitchen staff. Of the 55 school districts for which responses were received, 83% of the districts reported that administrators had never received any type of energy-related training. Further, 89% of the districts had faculty that had not

received training in energy conservation. Seventy-four percent of the school districts had janitors and maintenance personnel that had never participated in energy management educational program. Eighty-five percent of the school districts had kitchen staffs who had not participated in any type of energy management training. In the few instances where training had been presented, it was presented by a school district employee, such as the maintenance supervisor or kitchen manager, or someone outside of the system, such as LCES or an outside contractor.

Respondents were asked to rate a list of 14 energy management concepts from one to five based on their perception of how important these concepts were to include in an energy management educational program for maintenance and operations personnel. A rating was given for janitors/ custodians and maintenance personnel separately.

The reliability of each of the scales was estimated using the Cronbach's Alpha coefficient. Both scales were found to have an internal consistency coefficient of $\alpha = .92$. The mean importance of each of the items rated by respondents for inservice programs designed for maintenance personnel is presented in Table 28.

Table 28

Energy Management Concepts to be Included in an Educational Program for School Maintenance Personnel

Concept	Mean	SD
Preventive maintenance	4.78	.563
HVAC equipment	4.76	.647
HVAC controls	4.76	.571
Attitudes regarding energy conservation	4.75	.629
Equipment repair	4.68	.620
Refrigeration	4.63	.678
Air infiltration	4.51	.772
Equipment replacement	4.41	.826
Ventilation	4.37	.722
Lighting	4.24	.887
Hot water usage	4.20	.894
Calculating energy consumption	3.80	1.007
Reducing solar gain through windows	3.63	1.022
Landscaping for energy savings	3.18	1.146

The following interpretive scale was established by the researcher to determine the perceived importance of items for inclusion in an educational program:

> 4.5	Extremely Important
4.00 - 4.49	Very Important
3.50 - 3.99	Important
3.00 - 3.49	Include, if time allows
< 3.00	Low perceived importance (can be eliminated)

A total of seven items were rated by respondents in the extremely important category for inclusion in an educational program for maintenance

personnel. These items were: Preventive maintenance (mean = 4.78), HVAC equipment (mean = 4.76), HVAC controls (mean = 4.76), attitudes (mean = 4.75), equipment repair (4.68), refrigeration (4.63) and air infiltration (4.51). Additionally, four items were considered very important. Those items were: Equipment replacement (mean = 4.41), ventilation (mean = 4.37), lighting (mean = 4.24) and hot water usage (mean = 4.20). None of the 14 items had a mean less than 3.0.

Table 29

Energy Management Concepts to be Included in an Educational Program for Janitorial Personnel in Schools

Concept	Mean	SD
Attitudes regarding energy conservation	4.58	.883
Preventive maintenance	4.54	.793
HVAC controls	4.30	.953
Ventilation	4.22	.771
Hot water usage	4.22	1.028
Lighting	4.20	.929
Air infiltration	4.19	.945
HVAC equipment	4.15	.951
Reducing solar gain through windows	3.58	1.232
Equipment repair	3.54	1.088
Refrigeration	3.40	1.113
Landscaping for energy savings	3.08	1.093
Equipment replacement	3.00	1.109
Calculating energy consumption	2.71	1.232

The mean perceived importance and standard deviation of each of the items rated by respondents for energy management inservice training

programs designed for janitors/custodians is presented in Table 29. The same interpretive scale that was used for educational programs for maintenance personnel was used to determine the relative perceived importance of the items for janitors/custodians. Two items, attitudes (mean = 4.58) and preventive maintenance (mean = 4.54), had ratings in the extremely important category.

HVAC controls (mean = 4.30), ventilation (mean = 4.22), hot water usage (mean = 4.22), lighting (mean = 4.22), air infiltration (mean = 4.19) and HVAC equipment (mean = 4.15) were rated as very important for inclusion in the educational program for janitors/custodians. One item, calculating energy consumption (mean = 2.71), was perceived as being of low importance to this audience.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Purpose and Objectives The purpose of the study was to describe the status of energy use in Louisiana's public elementary and secondary schools. It sought to determine a per pupil and per square footage expenditure for energy and for maintenance and operations during the 1991-92 school year in the state's 66 public school districts and to determine the relationship between energy use and maintenance and operations expenditures. Additionally, it was intended to determine the need for a statewide energy management program and to identify energy management concepts to be addressed in such educational programs.

The specific objectives of the study were to:

1. determine energy usage and energy expenditures on a per student and per square footage basis for Louisiana's 66 public school districts and to determine the relationship between per student and per square foot expenditures;
2. compare the per square footage and per student expenditures for energy use in Louisiana with the regional averages;
3. compare the per square foot energy costs and the per student energy costs for each of the 66 school districts to the statewide average energy cost;

4. prioritize the 66 school districts within Louisiana in order of need for energy management assistance, to be determined by per pupil and per square foot expenditures;

5. determine a cost per square foot and cost per student for maintenance and operations;

6. determine the relationship between maintenance and operations expenditures and energy costs; and

7. determine the importance of selected concepts for inclusion in an educational program on energy management for school maintenance and operations personnel as perceived by study respondents.

Methodology Data for this study were collected via a mailed questionnaire which was designed by the researcher. The questionnaire was modeled after a similar study conducted by American Schools and Universities (1992). The instrument was validated by a panel of experts and field tested. The population consisted of the 66 public school districts in Louisiana. Questionnaires were mailed to persons within the school districts' administrative offices who had been identified by the superintendents as the appropriate respondents for the study.

Extensive non-response follow up techniques were utilized in an attempt to obtain a complete profile of the existing energy expenditure situation in the state's public school districts. Louisiana Cooperative

Extension Service area energy agents assisted in the data collection process. In addition to reminder post cards which were mailed two weeks following the initial mailing to potential respondents, area energy agents made numerous personal contacts by phone, letter and personal visits to school superintendents, maintenance supervisors and other school district personnel to gather data. An exhibit at a state school board association meeting manned by area agents and the researcher three weeks following the initial mailing produced numerous contacts, resulting in the completion of additional questionnaires.

Responses were received from 55 school districts. The Louisiana State Department of Education Annual Financial and Statistical Report for the 1991-92 school year (1992) was used to collect data regarding energy expenditures for the 11 school districts which did not respond. Statistical t-tests were conducted to determine if the school districts that responded to the questionnaire differed from those for which data were collected from the State Department study. Statistical t-tests were conducted on the variables number of students, number of schools, total utility expenditures and per student expenditures for energy. There was a significant difference between the two groups on each variable except per student expenditures for energy.

Data were analyzed according to the objectives of the study. Objective one resulted in the computation of energy use per student and per square foot and cost per student and per square foot for energy consumed in the school

districts. The computations for the first objective provided the basis for the analysis of objectives two through four. For objectives two and three, the computed costs for each district were compared to regional and state averages and analyzed individually for their deviations from those averages. Computed costs per student and per square foot were ranked in descending order to determine the prioritized listing of school districts to participate in an energy management program, which was the goal of objective four. Maintenance and operations costs per student and per square foot were calculated for objective five by adding all reported expenses pertaining to maintenance and operations and dividing the total by the number of students and by the total square footage. Pearson's Product Moment correlation coefficients were calculated to determine the relationships between maintenance and operations expenditures and energy expenditures to accomplish the sixth objective.

To accomplish objective seven, means and standard deviations were computed for each of the 14 items included in the list of concepts for consideration for inclusion in an educational program for maintenance and janitorial personnel. Items were ranked in descending order of means and interpreted based on the researcher-designed scale for relative importance of concepts.

Findings Fifty-five school districts reported a total of 78,996,380 square feet of buildings. The average square footage for an individual school

district was 1,716,819. Seventy-two percent of the gross square footage in Louisiana school buildings was reported to be greater than 20 years old. Twelve percent was less than 10 years old.

Louisiana's school districts spent approximately $67,446,763 on utilities, including electricity, natural gas, propane and water during the 1991-92 school year. The average school district expended $1,021,921 on energy.

Per student expenditures for energy ranged from $52.27 to $159.05. The mean expenditure was $92.17. School districts spent an average of $.74 per square foot on energy during the 1991-92 school year. Expenses of individual districts ranged from $.26 to $1.27 per square foot.

Regional averages reported school districts in the southern states spending $99.63 per student and $.77 per square foot for energy. Three-fourths of Louisiana's school districts were within one standard deviation above or below the regional average on expenditures per square foot. Sixty-one percent of the school districts reported per student expenditures which were within one standard deviation above or below the regional average.

When comparing individual school districts within the state with the state average, 26 (47%) reported average per student expenditures more than one standard deviation above or below the mean for the state. Twenty-six percent ($\underline{n} = 14$) reported per square foot expenditures within one standard deviation of the state average.

Total maintenance and operations expenditures reported for 53 school districts was $113,652,591. Individual school districts reported spending $161,878 to $17,214,449 for this budget item. The average total expenditure per district was $2,144,388. Approximately 85% of the total expenditures was spent on payroll and the remainder on outside contracts, equipment and supplies. A total of 5881 maintenance and janitorial personnel are employed in the 55 school districts for which responses were received.

Maintenance and operations expenditures per student ranged from $73.30 to $301.10. The mean expenditure was $149.22. Slightly over one-half expended less than $150 per student. The mean per square foot expenditure for maintenance and operations was $1.22. Expenditures for individual school districts ranged from $.38 to $2.33 per square foot.

No relationship was found between the variables maintenance and operations expenditures per student and energy expenditures per student. The calculated correlation coefficient was $r = .01$ ($p = .93$). A low, statistically non-significant association was found between the variables maintenance and operations cost per square foot and energy cost per square foot. The calculated correlation coefficient was $r = .26$ ($p = .06$).

Seven of the 14 concepts listed for consideration in an energy management education program for maintenance workers were perceived as extremely important by respondents. All items were considered worthy of inclusion in the educational program for maintenance personnel. Two items

were considered extremely important in programs for janitors. Six additional items were perceived as very important. One item was considered not important for educational programs for janitors.

Conclusions, Implications and Recommendations

The following conclusions, implications and recommendations are made based on the findings of this study.

Energy Use and Expenditures in Louisiana Public School Districts

- There is great variation in energy use and expenditures among Louisiana public school districts. This conclusion is based on the finding that there is a large range of both per student and per square foot expenditures for energy in the state. Per student expenditures for energy ranged from $52.27 to $159.05. Per square foot expenditures ranged from $.26 to $1.27. The school districts with the highest per student and per square foot expenditures have the greatest potential to benefit from energy management strategies to save dollars for education. Stephan (cited in Gardener, 1984) suggested that school districts could save 5 to 25% in energy expenditures by simply changing their method of operation in the school and an additional 25 to 30% with small capital improvements. The American Association of School Administrators (1992) estimated that schools could save 25% of their energy expenditures per year through improved energy efficiency.

It is recommended that opportunities for energy efficiency improvements be identified through energy audits conducted by experts in the

field of energy management. Private energy management firms, engineering firms, or LCES can be contacted to perform these audits and make recommendations for energy improvements. It is further recommended that schools which have relatively low per student and per square foot expenditures for energy be studied to determine what is being done to maintain low energy expenses.

In addition, the researcher recommends that school personnel be given an incentive to save energy dollars. This incentive plan should be established at the school district level and include everyone on the school campus from the principal to the faculty, staff and students. The incentive program could be accomplished by the implementation of a shared savings program in the school districts through which schools that reduced energy expenditures could get some of the actual dollar savings back to use in the school for supplies, equipment, etc. An incentive program to produce energy savings could provide much needed motivation for schools to improve energy efficiency.

It also is recommended that a study be conducted to determine specific actions that can be taken to improve the energy efficiency of campuses in Louisiana school districts. This could be accomplished by conducting energy audits of existing school facilities to look for wasteful energy practices and inefficient energy-consuming equipment. Attention should be focused on those school districts with the highest costs per student and costs per square foot to determine ways they might cut energy expenditures.

- The majority of Louisiana schools are not designed for energy efficiency. This conclusion is based on the finding that 72% of Louisiana school buildings are over 20 years old. From LCES walk-through audits in public schools, it has been determined that many of Louisiana's school buildings are in a state of disrepair due to a lack of preventative maintenance. To add to the energy waste problem, older schools were not originally designed for air conditioning. Most have been renovated and air conditioning added, but how has this renovation affected energy use? Older schools traditionally had many windows to provide for ventilation and very little insulation in the building envelope. When the air conditioning was added, if insulation was not added and some of the windows removed, then utility expenses literally could be going out of deteriorating windows and walls. The majority of these older schools also have undergone asbestos abatement since the enactment of Public Law 98-377 (United States Statutes at Large, 1986). When the asbestos was removed, many school systems did not have the funds to replace the asbestos with any other type of insulating material.

The age and condition of Louisiana's school buildings is typical throughout the country. It was reported in a 1992 study by the American Association of School Administrators that 74% of the nation's schools were built prior to WW II or during the 1950s-60s era of cheap construction and cheap energy to meet the demands of the baby boom and are, for the most part, not energy efficient.

It is recommended that school buildings in Louisiana be brought up to energy efficiency standards. The addition of insulation and energy efficient lighting systems and the elimination of excessive windows, along with other energy-saving measures should be considered in renovation.

It also is recommended that if new construction is an option for school districts, energy efficient construction techniques and equipment should be considered as a good energy saving investment.

It is further recommended that research be conducted to determine the specific effects of the age of school buildings on energy consumption. Research to determine if older school buildings in fact have higher utility bills than newer schools is needed. Some of the newer, more modern schools have been designed more for aesthetics than for energy efficiency. How do these 'monuments to architects' compare with older schools in energy efficiency? Are they as wasteful in energy use as older schools, for different reasons?

- Schools are not held accountable by school districts for energy expenditures. Many principals do not see copies of the utility bills at their schools, nor do they have any idea of the extent of their annual energy expenditure. This finding is consistent with LCES energy audits of Louisiana schools in the pilot program (1992). Fifty percent of respondents reported that someone, primarily principals, at the individual schools received copies of utility bills on a monthly basis. It was further determined by this study that

63% of those receiving copies of bills at the school level do not monitor or evaluate those bills each month. It is recommended that individual schools be held accountable for their energy expenditures. School principals should be encouraged to monitor energy expenditures monthly, to compare each monthly expenditure with previous expenditures and examine any change in expenditures. The researcher further recommends that an instrument be developed at the state level that each school district could utilize to monitor energy expenditures. Principals should then be trained in recommended monitoring procedures and provided with the resources necessary to implement the monitoring plan.

Comparison of Energy Use in Louisiana with Other Southern States

- Louisiana school districts expend slightly less than the regional average per square foot and per student on energy. The regional average per square foot expenditure reported in the 1992 American Schools and Universities study (Agron, 1992) was $.77 per square foot. The calculated average for Louisiana was $.74 per square foot. School districts in the south spend, on the average, $99.63 per student on energy. This study found Louisiana school districts spending $92.17 per student.

Although the per student and per square foot expenditures are comparable to those of the other southern states, there is still room for improvement where energy expenditures are concerned. It is recommended that each school district in the state evaluate its current energy use and set

a reasonable goal to reduce energy consumption. School personnel should be encouraged to maintain the reduced level of consumption through wise energy management practices. Based on Smilie and Carl's (1992) study which purports that energy consumption can be reduced by as much as 25% by simply implementing a regularly scheduled preventative maintenance program, the Federal Energy Administration's (1977) estimation that commercial and school facilities in the south could reduce energy consumption by 37% by bringing their buildings up to standard and the age of Louisiana schools, great potential exists for reducing energy consumption in Louisiana's public schools. These two methods combined could result in a savings of over 50% in utility expenditures. Smith (1986) further suggests that energy costs and consumption in schools can be reduced by up to 30% by investing in energy conservation measures which have a two-year or less payback. Once a reduction in energy expenditures is realized, the goal of school administrators should become to maintain this level of energy management consciousness and keep utility costs under control.

The researcher recommends further research to determine specific paybacks and benefits for energy management upgrades for individual schools. This analysis could include not only the upgrading of energy-consuming equipment, but also the specific effects of such practices as adding or upgrading insulation, retrofitting lighting systems, removing windows and adding landscaping for energy management.

Maintenance and Operations

- Louisiana public school districts spend considerably less than the regional average on maintenance and operations. This conclusion is based on the finding that the mean expenditure per student for maintenance and operations in Louisiana is $149.22, while Agron (1992) reported the southern region average expenditure per student to be $239.93. The calculated mean for per square foot expenditures for maintenance and operations in Louisiana was $1.22. The Agron study determined the regional per square foot expenditure to be $1.79. It should be noted that budgetary items included in this comparison are payrolls for janitors/custodians and maintenance, outside energy management and maintenance contracts and supplies and equipment. Utilities have been removed from this analysis, as they are analyzed separately.

Shaw (1993) points out that school systems scrimping on maintenance and operations may be faced with higher expenditures on utilities and/or manpower due to the inefficient operation of energy consuming equipment. It is recommended that Louisiana school districts place high priority on bringing equipment up to standard and increasing the energy efficiency of the equipment. This recommendation is secondary to the previous recommendation concerning bringing buildings up to standard and supplementary to the following recommendation regarding training for maintenance and operations personnel. Increasing the energy efficiency of

equipment is an exercise in futility if buildings have air leaks and maintenance personnel are not trained to maintain the efficiency of the upgraded equipment.

It is further recommended that each school district in the state employ additional maintenance and operations personnel for the sole purpose of performing preventative maintenance measures. Schools with very large physical plants might need one person for each school to conduct routinely scheduled preventative maintenance on all energy-consuming equipment which is not covered by outside maintenance contracts. In the case of smaller schools, one person could be responsible for multiple schools. Very small school districts might have just one person for the entire district employed for this purpose. Although the employment of additional personnel will cost the school districts some money, the added positions may pay for themselves in energy savings.

It is also recommended that once the appropriate personnel are employed and trained, stringent preventative maintenance plans for HVAC and refrigeration equipment be formulated and implemented. These plans are necessary to insure that all energy-consuming equipment functions efficiently. The preventive maintenance plan also should identify specifically which personnel are responsible for which tasks and include an evaluation procedure to determine if the tasks have been accomplished. The plan should be monitored to determine its effect on energy consumption for a period of at

least two years. It should be evaluated constantly and revised to meet the changing demands of the system. Preventative maintenance will require some financial investment for personnel and supplies, but will pay for itself in a short period of time.

Most Louisiana schools do not have written policy guidelines regarding operations and maintenance procedures. This conclusion is based on the finding that well over 50% of school districts reported having no written policies pertaining to HVAC and refrigeration equipment, lighting, kitchens or building structures. For those reporting written policies, they were perceived as being moderately effective. This may lead one to question to what degree the policies have been implemented and who monitors the implementation.

It is recommended that all school districts devise and implement written policies and procedures regarding the operations and maintenance of HVAC and refrigeration equipment, lighting, kitchens and building structures. Policies should be designed to specifically address the needs of each individual physical plant in the schools. Maintenance personnel must be trained to implement the written policies and be given the resources to do so. For example, if the written policy is to replace HVAC filters every month, then a supply of filters must be made available to maintenance personnel. Someone should be responsible for the monitoring and implementation of written policies. Written policies should be evaluated and updated periodically, as needed. These recommendations are consistent with the success of the Total

Energy Management Process (TEM) implemented in Minnesota (Minnesota State Department of Energy and Economic Development, 1983) which has as a critical step, to establish an energy policy statement and monitor the implementation of that statement.

It is further recommended that a complete energy management plan be designed for each school district. As supported by Gardener (1984), Zachar (1985a, 1985b) and LeMaster (1983), the plan should contain administrative commitment, the establishment of an energy policy, the involvement of everyone in the school, conducting energy audits and monitoring progress of the program. Research should be conducted to determine the relationship between written operations and maintenance policies which are enforced and monitored and energy use.

Relationship between Energy Expenditures and Maintenance and Operations Expenditures

- It can be concluded from the study that no relationship exists between energy expenditures and maintenance and operations expenditures in Louisiana's public school districts. This conclusion is based on the computed correlation coefficient of $r = .01$ ($p = .93$) for the relationship between the per student expenditures for energy and per student expenditures for maintenance and operations. A low association, although not statistically significant, exists between per square foot expenditures for energy and per square foot expenditures for maintenance and operations. The correlation coefficient calculated for the per square foot variables was $r = .26$ ($p = .06$).

It is recommended that additional research be conducted to identify other factors which are related to energy expenditures in schools. Areas for study might be age of the building, construction materials, type of structure (i.e. flat versus gabled roof), amount of insulation, number of windows, level of education and expertise of maintenance personnel, type and condition of HVAC and refrigeration equipment, HVAC and refrigeration equipment maintenance schedules, outside energy management or equipment HVAC and refrigeration maintenance contracts, the monitoring of energy expenditures from a central source (i.e. whether or not someone in the central office is responsible for monitoring energy expenditures), utility rates, operations procedures and attitudes of school personnel regarding energy management.

Energy Management Educational Programs for School Personnel

- Changing attitudes of maintenance and janitorial personnel is critical to effectively implementing an energy management program in Louisiana public schools. This conclusion is based on the finding that the concept "attitudes" received mean perceived importance scores of 4.75 and 4.58, respectively, on five point scales for maintenance and janitorial personnel. In addition, "attitudes" was ranked highest on the scale for custodians and third on the scale for maintenance personnel. Based on the interpretive scale developed by the researcher, both of these scores indicated the perceived importance as extremely high. Changing attitudes toward energy

management could result in changing day-to-day operating practices, which can result in lower energy expenditures.

It is concluded further that energy management educational programs for janitorial and maintenance personnel should include the following concepts: Preventive maintenance, HVAC equipment, HVAC controls, equipment repair, refrigeration, air infiltration, equipment replacement, ventilation, lighting, hot water usage, solar gain and landscaping for energy savings. Programs for maintenance personnel also should include calculating energy consumption. This conclusion is based on the mean perceived importance scores listed for each of these concepts in Tables 23 and 24. Each concept, except calculating energy consumption, received a mean importance score of more than 3.0, which is interpreted to be important for inclusion in an energy management educational program.

These conclusions are in agreement with the findings of Smith (1986), Stephan (cited in Gardener, 1984) and the Federal Energy Administration (1977) who concluded that maintenance of equipment and daily operating practices have the largest potential for saving energy expenditures in schools.

It is recommended that energy management educational programs for maintenance and janitorial personnel include a thorough explanation of the importance of energy management in an attempt to improve their attitudes regarding energy conservation. Preventive maintenance on all heating, air conditioning, ventilation and refrigeration equipment and operation of HVAC

controls should be stressed as a means of conserving energy, as these have the largest potential for saving energy.

It is recommended that an energy management program which includes pertinent energy concepts be designed for each school district. Consideration should be given to the various educational levels, technical expertise levels and different equipment types when designing the educational program. Due to the technical nature of most of the subject matter, it is recommended that the demonstration method and hands-on experience be provided in lieu of lectures. Audio-visuals also should be considered.

- Energy education is not a high priority with Louisiana public school systems. This conclusion is based on the finding that, of the 55 school districts for which responses were received, 83% of the districts reported that administrators had never received any type of energy-related training. Further, 89% of the districts had faculty that had not received training in energy conservation. Seventy-four percent of the school districts had janitors and maintenance personnel that had never participated in energy management educational programs. Eighty-five percent of the school districts had kitchen staffs who had not participated in any type of energy management training.

It is recommended that educational programs and seminars on energy management be conducted at least on an annual basis not only for all maintenance and operations personnel, but also for administrators, faculty and kitchen staff. The duties and responsibilities of each employee, as they relate

to energy management, should be reviewed and the latest in technology which is appropriate to their respective roles should be presented. The educational programs and seminars should be coordinated through the central school district office and may be presented by central office staff or by some other expert in the field of energy management. Utility company consumer service employees, equipment dealers and representatives, Louisiana Cooperative Extension Service specialists and energy management services contractors can be good sources of information and excellent resources for the educational programs. Inservice training programs on energy management for all school district personnel should become a high priority of the system as a whole and receive the full support of school administrators because of its potential for saving valuable education dollars. Vance and Kieley (1984) concur that in order for an energy management program to be successful it must be clearly defined as a management goal. It must be supported then with the appropriate resources for implementation, both financial and human.

REFERENCES

Acosta, D. (1992). Final Report: Louisiana Energy Education for Tomorrow Program. Prepared for Louisiana Department of Natural Resources by Louisiana Cooperative Extension Service engineering staff. Baton Rouge: Louisiana State University Agricultural Center.

Agron, J. (1992). Budgets get much-needed boost. American Schools and Universities, 64(8), 33-36.

Agron, J. (1993). A drop in the bucket. American Schools and Universities, 65(8), 28-32.

American Association of School Administrators. (1992). Schoolhouse in the Red: Cutting our losses. A national study of school facilities and energy use. Management summary. Arlington, VA. (ED 344 339).

American Association of School Administrators, Council of the Great City Schools and National School Boards Association. (1983). The maintenance gap: Deferred repair and renovation in the nation's elementary and secondary schools. A joint report. Arlington, VA. (ED 231 065).

Association of School Business Officials of the U.S. and Canada. (1982). School facilities maintenance and operations. As presented during special sessions on energy management and maintenance and operations at the 67th Annual Meeting and Exhibits of the Association of School Business Officials of the U.S. and Canada, Kansas City, MO, October 12, 1981. (ED 231 024).

Baker, G. (1992). History of Cooperative Extension Service's Energy Education Efforts. Baton Rouge: Louisiana State University Agricultural Center.

Bontrager, R. L. & Hubbard, C. W. (1977). A model for education: Energy-water consumption decision making. (ED 133 899).

California Energy Extension Service. (1989). Bright Ideas. Governor's Office of Planning and Research. Sacramento, CA.

Canadian School Trustees Association. (1987). Energy management in schools. Ottawa, Ontario. (ED 291 643).

Canipe, S. L. (1979). Perspectives on school energy use. North Carolina. (ED 182 804).

Davis, J. A. (1971). Elementary survey analysis. Englewood Cliffs, NJ, Prentice-Hall.

Education Commission of the States. (1983). Energy education as we leave it. Final report. Denver, CO. (ED 237 345).

Federal Energy Administration. (1977). National survey of public school district energy costs. Summary report. Washington, DC. (ED 133 873).

Gardener, C. (1984). Energy conservation in small schools. Las Cruses, NM. Eric Clearinghouse on Rural Education and Small Schools. (ED 261 818).

Gay, L. R. (1981). Educational research: Competencies for analysis and application. (2nd ed.). Columbus, OH: Charles E. Merrill Publishing Company.

Hansen, S. J. and Associates, Inc. (1982). School energy management: An analysis of energy conservation measures under the schools and hospitals program. Lake Jackson, TX. (ED 282 344).

Hansen, S. J. and Associates, Inc. (1984). Energy implications for school finance. School Business Affairs, 50(7), 16,45.

Hussar, W. J. (1992). Projections of educational statistics to 2002. Pocket projections. Washington, DC: National Center for Education Statistics. (ED 343 947).

Johnson, F. (1992). Public elementary and secondary state aggregate data for school year 1990-91 and fiscal year 1990. Washington, DC: National Center for Education Statistics. (ED 347 203).

Kent, H. (1986). Striving for the best in maintenance and food service. School Administrator, 43(5), 10-12.

LeMaster, T. J. (1983). How our district successfully faced the challenge of energy conservation. School Business Affairs, 49(4), 48-50.

Louisiana Cooperative Extension Service. (1990). "Job Descriptions Area Energy Agents". Unpublished Job Description, January, 1990. Baton Rouge: Louisiana State University Agricultural Center.

Louisiana Cooperative Extension Service. (1992). Reports of Class A Audits of Selected Louisiana Schools. Baton Rouge: Louisiana State University Agricultural Center.

Louisiana Department of Natural Resources (1992). Phase II State Plan: Institutional Conservation Program. Baton Rouge, LA.

Louisiana Department of Natural Resources Division of Research and Development. (1983). Energy Conservation Publication for School Buildings. Baton Rouge, LA.

Louisiana Department of Natural Resources, Energy Research and Planning Division. (1985). Administrator's Guidebook to Energy Management in Schools. Baton Rouge, LA.

Louisiana State Department of Education. (1992). Annual Financial and Statistical Report: Part IIA. Baton Rouge, LA.

Lukco, B. J. (1981). Energy conservation management for school administrators: An overview. Columbus, OH: Eric Clearinghouse for Science, Mathematics and Environmental Education. (ED 209 107).

Migliorino, J. (1980). Preventative maintenance. Paper presented at the 66th Annual Meeting of the Association of School Business Officials, New Orleans, LA, October 26-30, 1980. (ED 196 158).

Minnesota State Department of Energy and Economic Development. (1983). Total energy management: Award winning projects of Minnesota schools. St. Paul. (ED 245 920).

Minning, W. R. (1987). Strategy plan strengthens energy conservation program. School Business Affairs, 53(2), 18-19, 42.

Myers, D. (1992a, August 19). "Sacred cow" education most costly budget item. Baton Rouge Advocate, p. 1-A.

Myers, D. (1992b, September 29). School system backers hope to defeat constitutional plan to cut funds. Baton Rouge Advocate, p. 2-B.

National Center for Education Statistics. (1992). American education at a glance. Washington, DC. (ED 343 946).

National Education Association. (1991a). Estimates of school statistics, 1990-91, as provided by the state departments of education. Data search. Washington, DC: Research Division. (ED 343 213).

National Education Association. (1991b). Rankings of the states, 1991. Data search series. Washington, DC: Research Division. (ED 343 210).

Nordeen, H. (1983). Energy retrofits can ease the budget squeeze. School Business Affairs, 49(4), 52-53.

Office of Technology Assessment. (1982). Energy Efficiency of Buildings in Cities. Congress of the U.S. Washington, D.C.

Pond-Brevik, M. (1987). Letting go: An approach to energy management. CEFP Journal, 25(1), 9-11.

Rankin, J. (1987). Energy: A force for change. CEFP Journal, 25(1), 7-9.

Rasmussen, W.D. (1989). Taking the University to the People: Seventy-five years of Cooperative Extension. Ames: Iowa State University Press.

Rose, P. (1984). Creative energy management can save you money. School Business Affairs, 50(7), 26, 39.

Rose, P. (1985). The high cost of saving energy dollars. School Business Affairs, 51(7), 58-59, 61.

Schreiber, M. & Paige, H. E. Sr. (1976). A case study of complete energy management at the Herricks Union Free School District. New Hyde Park, NY. (ED 130 397).

School Business Affairs. (1984). School reduces energy costs 31% with guaranteed savings agreement. 50(11), 50-51.

Scott, L. C., Richardson, J. A. & Jamal, A. M. M. (1992). The Louisiana Economic Outlook: 1993 and 1994. Baton Rouge, LA: Louisiana State University.

Shaw, R. (1993). Maintenance management: Rescuing our gains. American School and University, 65(5), 22.

Shuler, M. (1992, August 26). Convention could cut two ways on budget. Baton Rouge Advocate, p. 9-B.

Smilie, J. L. & Carl, M. (1992). Final report: Small Business Air Conditioning, Heating and Refrigeration Educational Program. Prepared for the Louisiana Department of Natural Resources by Louisiana Cooperative Extension Service engineering staff. Baton Rouge: Louisiana State University Agricultural Center.

Smith, M. W. (1986). Invest in energy conservation with government help. School Business Affairs, 52(2), 26-27.

Stern, J. (1984). Flexibility the key to cutting energy costs. Paper presented at the Annual Meeting of the National School Boards' Association, Houston, TX, March 31-April 3, 1984. (ED 247 643).

U.S. Department of Energy. (1984). Institutional Manager's Guide to Energy Conservation. Washington, D.C.: Office of State and Local Programs.

U.S. Department of Energy. (1988). Program activities: DOE state and local assistance programs: 1988 Report. Washington, DC: DOE/CE-0251.

U.S. Department of Energy. (1992). State energy data report consumption estimates, 1960-1990. Washington, DC: Energy Information Administration, Office of Markets and End Use. DOE/EIA-0214(90).

United States Congress. (1992). Comprehensive national energy policy act: Report of the Committee on Energy and Commerce, House of Representatives, together with additional and supplemental views (to accompany H.R. 776). Washington, DC: U.S. Government Printing Office.

United States Statutes at Large. (1986). Laws and concurrent resolutions enacted during the second session of the ninety-eighth Congress of the United States of America. Volume 98, part 2 (Public Laws 98-370 through 98-515). Washington, DC: U.S. Government Printing Office.

Vance, D. G. & Kieley, J. D. (1984). Confused by energy saving claims? Help is available. School Business Affairs, 50(7), 22-23, 61.

Vander Vliet, G. C. (1993). Market outlook: Charting new courses--Finance. American School and University, 65(5), 49.

Vote for cc/92 amendment. (1992, October 29). Baton Rouge Advocate, p. 6-B.

Wiles, M. M. (1982). E + S = $ (squared). Energy in schools costs too much: A report on the impact of energy costs on New York state schools. Albany, NY: New York State Senate Research Service. (ED 218 804).

Wiley, J. R. (1988). Energy management: Maintaining a cost effective, quality environment for learning. A case study of program development and operation. Excerpted from a presentation at the Annual Meeting of the Association of School Business Officials for the U.S. Department of Energy, Region 5, Detroit, Michigan, October 4, 1988. (ED 308 576).

Williamson, D. (1986). Energy conservation and historic properties. School Business Affairs, 52(2), 28, 45.

World Eagle, Inc. (1990). The United States today: An atlas of reproducible pages. Wellesley, MA. (ED 327 425).

Zachar, S. (1985a). Energy is a resource: Master-plan to use it wisely. Part I. American Schools and Universities, 57(12), 8, 10, 12.

Zachar, S. (1985b). Energy is a resource: Part II. American Schools and Universities, 58(1), 52, 54.

APPENDIX A: QUESTIONNAIRE

Louisiana State University
Agricultural Center
Louisiana Cooperative Extension Service

Louisiana Department
of Natural Resources

SCHOOL ENERGY USE PROFILE

Please supply the following information for the 91/92school year. Unless otherwise indicated, answers should be for **ALL** public schools in your parish. Please answer all questions even if you provide an estimate. Precede all estimates with **EST**.

1. Total number of schools _____

2. Total number of students _____

3. **Gross** square footage of all buildings.

   less than 10 years old _____

   11 - 20 years old _____

   more than 20 years old _____

4. Total square feet **COOLED** _____ **HEATED** _____

5. **Expenses related to maintenance of buildings and grounds**:

   a. **Total payroll** (including fringe benefits and overhead if possible)

   Custodial: _____ Maintenance: _____

   b. **Average** annual salary for **fulltime employees** only (excluding fringe benefits)

   Custodial: _____ Maintenance: _____

   c. Does the school board have any outside contracts which include:

Maintenance	YES	NO
Energy Management	YES	NO

   d. If there are outside maintenance and/or energy management contracts:

   Cost & length of term _____ Description _____

   Cost & length of term _____ Description _____

   Cost & length of term _____ Description _____

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5. e. If the school board does not currently have an outside maintenance or energy management contract, is it considering one?

YES NO

6. Costs of maintenance equipment and supplies not included in any maintenance contract. Include cleaning supplies, ladders, tools, refrigerants, air filters, etc.

_____

7. Total utility usage and cost and suppliers (LP&L, GSU, SWEPCO, etc.) for 1991-92:

	UNIT	QUANTITY	TOTAL COST	SUPPLIERS
ELECTRICITY	Killowatt-hours	_____	_____	_____
NATURAL GAS	CCF__ or MCF__	_____	_____	_____
OTHER Non-transportation	_____	_____	_____	_____
WATER	CF	_____	_____	

8. **TOTAL of all school board expenditures for the 1991-92 school year EXCLUDING the cost of student transportation, capital outlay and debt service.**

_____

9. Number of **PERSONNEL:**

	CUSTODIANS/JANITORS	11 or 12 Months	9 or 10 Months	Other (Please specify)
a.	Fulltime (greater than 30 hours)	_____	_____	_____
b.	Parttime (30 hours or less)	_____	_____	_____
	MAINTENANCE			
c.	Fulltime (greater than 30 hours)	_____	_____	_____
d.	Parttime (30 hours or less)	_____	_____	_____

10. **Monitoring of energy use**

a. Who receives copies of utility bills on a monthly basis? Check all that apply.

District level

____ Superintendent
____ Fiscal manager
____ Maintenance supervisor
____ Other (Please specify)

_____

____ No one

School level

____ Principal
____ Assistant Principal
____ Other (Please specify)

_____

____ No one

10.b. Are utility bills evaluated monthly to identify irregularities in energy use?

District level	If yes, who evaluates?	School level	If yes, who evaluates?
___ YES	_____	___ YES	_____
___ NO		___ NO	
___ Don't know		___ Don't know	

11.a. Are there written policies for the areas listed below? Policies for operation would cover items such as temperature settings for cooling and heating equipment, hours of kitchen hood operation, when lights should be turned off, and when windows are allowed open for ventilation. Maintenance policies include such things as how often air filters are to be replaced, when air conditioning coils are cleaned, replacing old light bulbs or fixtures with high efficiency ones, inspecting weatherstripping regularly. Place an **X** in the blank if there are written policies regarding these practices.

	Operation	**Maintenance**	**If there are written policies, in your opinion, how effective have they been? Rate 1-5 with 1 being not effective and 5 being very effective.**
A/C, Heating, Refrigeration	_____	_____	1 2 3 4 5
Lighting	_____	_____	1 2 3 4 5
Kitchens	_____	_____	1 2 3 4 5
Building structures	_____	_____	1 2 3 4 5

11b. If there are written policies, who sees that they are enforced? (school principal, assistant superintendent, maintenance supervisor, etc.)

_____ Position or title

12. In what school year was energy-related training last provided for the following groups and by whom was it provided?

		Training NOT Provided	YEAR	**PROVIDED BY:** District Personnel (Title or Position)	Other (Specify)
a.	School administrative staff	_____	_____	_____	_____
b.	Faculty	_____	_____	_____	_____
c.	Custodians	_____	_____	_____	_____
d.	Kitchen staff	_____	_____	_____	_____
e.	Maintenance staff	_____	_____	_____	_____

13. Is energy-related training planned for any of the groups listed in the previous question in the next 12 months? If yes, by whom?

Group	Who will provide training?
_____	_____
_____	_____
_____	_____

14. Below is a list of concepts related to energy use and energy conservation. In your opinion, how important is it that energy-related training for school maintenance personnel and janitors include these concepts. Rate the importance of the concepts, with 1 being "not important" and 5 being "very important".

	Maintenance Personnel					Janitors/Custodians				
Preventative maintenance	1	2	3	4	5	1	2	3	4	5
Air infiltration	1	2	3	4	5	1	2	3	4	5
Landscaping for energy savings	1	2	3	4	5	1	2	3	4	5
Heating and air conditioning equipment	1	2	3	4	5	1	2	3	4	5
Heating and air conditioning controls	1	2	3	4	5	1	2	3	4	5
Ventilation	1	2	3	4	5	1	2	3	4	5
Refrigeration	1	2	3	4	5	1	2	3	4	5
Reducing solar gain through windows	1	2	3	4	5	1	2	3	4	5
Lighting	1	2	3	4	5	1	2	3	4	5
Equipment repair	1	2	3	4	5	1	2	3	4	5
Equipment replacement	1	2	3	4	5	1	2	3	4	5
Calculating energy consumption	1	2	3	4	5	1	2	3	4	5
Attitudes regarding energy conservation	1	2	3	4	5	1	2	3	4	5
Hot water usage	1	2	3	4	5	1	2	3	4	5

15. Please attach a copy of the following documentation, if available, to help us with further analysis of your energy conservation education needs:

A. **JOB DESCRIPTIONS** for parish and/or school maintenance personnel and school janitors/custodians

B. Written **OPERATIONS** and **MAINTENANCE PROCEDURES/POLICIES**

C. **FISCAL REPORT** for 1991-92 school year

16. Name of person supplying this information _____

Title _____

Address _____

_____

Phone Number _____

School District or Parish _____

Thank you for taking time to supply us with this information. We sincerely appreciate your time, effort and cooperation as we work together to reduce energy consumption in Louisiana schools and more efficiently use valuable education dollars.

Please feel free to make any additional comments below.

APPENDIX B: COVER LETTER

Louisiana State University
Agricultural Center
Louisiana Cooperative Extension Service

January 20, 1993

Dear

As dollars budgeted for education become more scarce, school systems around Louisiana are looking for ways to cut expenditures. The last place anyone wants to cut is in the services which directly affect the education of the children. Therefore, all other budget categories will require careful scrutiny to determine ways in which the budget can be trimmed.

Several school superintendents around the state have requested the assistance of the LSU Agricultural Center, Louisiana Cooperative Extension Service (LCES), and the Department of Natural Resources (DNR) Energy Division in cutting utility expenditures in their school budgets. In order to fulfill this request, energy audits were conducted in selected schools in South Louisiana. The results of the audits revealed opportunities for improvement in schools' use of energy-consuming appliances and equipment.

LCES and DNR have joined their resources in a project called "Energy and Education for a Brighter Tomorrow", designed to help public school districts in the state reduce energy expenditures. In order to do so, it is necessary to gather information regarding the facilities and maintenance personnel in each school district in the state. Your name has been supplied to us as the person who would most likely have access to the information we are requesting. In some cases, more than one copy of this survey is being sent to a district upon the request of the Superintendent. **Only one copy of the survey need be returned for each district.**

Plans are to follow this survey with educational programs on energy conservation for school administrators, maintenance, janitorial and custodial personnel, food service staffs, faculty and students. Even if your school district is not interested in participating in the energy management and education program, please fill in the enclosed questionnaire and return it to Debra Acosta by **February 8, 1993** in the enclosed business reply mail envelope. We are attempting to determine the per pupil expenditure for energy and operations and maintenance in the state's public schools and to determine the need for a comprehensive energy education program in Louisiana's 66 public school

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districts. Data collected from this study will be used in a grouped format and school districts will not be identified separately. Data specific to your district will not be released to anyone without the prior approval of the school superintendent.

Please feel free to call Debra Acosta or Mike Carl at (504) 388-2229 if you have any questions regarding the information requested. We sincerely appreciate the time you spend responding to this questionnaire. We believe the outcome of the "Energy and Education for a Brighter Tomorrow Program" will provide much needed relief to Louisiana's financially overburdened school districts.

Sincerely,

Ralph E Ricardo

Ralph Ricardo
President-elect
Louisiana School
Superintendent's Association

Billy Arcement

Billy Arcement
President
Louisiana School
Board Association

Debra T. Acosta

Debra T. Acosta
Extension Associate (Energy)
Project Coordinator

Enclosure
cc: Wade Byrd

APPENDIX C: FOLLOW-UP POSTCARD

Louisiana State University
Agricultural Center
Louisiana Cooperative Extension Service

****IMPORTANT REMINDER****

February 8, 1993

Recently you received a survey regarding energy use and maintenance and operations procedures in your parish schools. The data collected from this study will be used to analyze energy consumption patterns and expenditures for public schools throughout the state. Following the completion of the study, a program will be designed to assist public school systems in reducing energy costs. If you have completed and returned the survey to us, thank you for your time and effort. If you have not yet completed the survey, please do so soon. Your response is very valuable to the completion of this project. Should you have any questions, you may contact me at (504) 388-2229 and I'll be glad to put you in immediate contact with someone who can help you fill out the survey.

Sincerely,

Debra T. Acosta

Debra T. Acosta, Extension Associate (Energy)

VITA

Debra Ann Theriot Acosta was born in Baton Rouge, Louisiana, February 10, 1956. In May 1974, she graduated from Brusly High School in Brusly, Louisiana. She entered Louisiana State University in January 1976 and received her Bachelor of Science degree in Home Economics, with a minor in Extension Education in May 1980. Acosta was employed with the Louisiana Cooperative Extension Service in Iberville Parish as a 4-H agent from October 1980 until May 1990. She received a Master of Science degree in Home Economics in December 1985 and enrolled in the Ph.D. program in Louisiana State University's School of Vocational Education in August 1988. In May 1990 Acosta was transferred to the Louisiana Cooperative Extension Service state office as an Extension Associate assigned to energy education work. She has two children, Rebecca Lynn and Charles Michael, and they reside in Port Allen, Louisiana.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Debra T. Acosta

Major Field: Vocational Education

Title of Dissertation: Energy Management in Louisiana's Public School Districts

Approved:

Michael J. Burnett
Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

Patricia Verma

Joe Katilek

Francis C. Lawrence

Barbara A. Holt

Jerry J. Maxey

Date of Examination:

June 18, 1993